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VICTORIA AND ALBERT MUSEUM

IRONWORK

PART I. FROM THE EARLIEST TIMES TO
THE END OF THE MEDIÆVAL
PERIOD

BY

J. STARKIE GARDNER

REVISED BY

W. W. WATTS, F.S.A.

ILLUSTRATED

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Though the collection in the Ironwork Gallery of the Victoria and Albert Museum is perhaps the most extensive and comprehensive extant, it has yet been necessary to take many of the illustrations of mediæval work from among the fixtures in ancient ecclesiastical buildings, where many of the types can alone be seen. Several of these illustrations have been lent by the Austrian Government Printing Office, and Mr. Murray has kindly allowed the use of two of his woodcuts from Du Chaillu's *Viking Age*. In addition to these, my sincere thanks are due to many of the clergy, and to friends in the architectural profession, for the trouble they have taken in affording or procuring information, which the condensed character of the book has rendered it impossible to acknowledge individually.

The present volume breaks off at the end of the Mediæval period. A second deals with the subject through the Renaissance to the present day.

November, 1892.

PREFACE TO SECOND EDITION.

THE present volume has been revised to date and a large number of additional illustrations inserted. These have mostly been reproduced from objects in the collection of ironwork in the Victoria and Albert Museum.

March, 1907.

PREFACE TO THIRD EDITION.

IN this volume additional information has been given as to the extent and knowledge of the craft which prevailed under the Britons and Anglo-Saxons; and several illustrations of important examples of ironwork have been added. The

PREFACE.

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thanks of the Board are due to Mr. J. Starkie Gardner for having undertaken the work of revision and for having provided material for several of the new illustrations.

CECIL SMITH.

May, 1914.

PREFACE TO FOURTH EDITION.

THE preparation of this volume has been entrusted to Mr. W. W. Watts, formerly Keeper of the Department of Metalwork. While the work remains substantially that of Mr. Starkie Gardner it has been carefully revised in order to bring it into agreement with the latest knowledge on the subject. The steady growth of the Museum collection of wrought ironwork has rendered possible the inclusion of new illustrations which will considerably enhance the interest of the book.

It is hardly possible to say whether the objects referred to as in France and Belgium still exist : many certainly remain, but some were probably lost during the War.

ERIC MACLAGAN.

September, 1927.

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IRON WORK.

INTRODUCTION—IRON AND ITS ORES.

NO material subject is more worthy of study than iron, for no substance on earth has more profoundly influenced the destinies of the human race. In intrinsic value it ranks lowest among metals, for copper is fifteen times more costly, and even zinc and lead are six to eight times dearer by weight. Yet, though it is the cheapest and most ubiquitous of metals, lacking, moreover, many of the intrinsic qualities of the precious metals, it nevertheless immeasurably surpasses the whole of them together in interest and in its value and utility to us. It stands, indeed, as regards its principal attributes, precisely among the metals as the working masses stand in a civilised community, and has ever proved a most mighty instrument for good or ill.

Clean iron is in colour a metallic steely grey, but it oxidises, or rusts, on exposure to damp air so rapidly that its real colour is seldom apparent in works of art, unless the surface has been pressed or polished, when it presents a bright metallic lustre, glistening and reflecting light. Of purely scientific interest are its well-known peculiarities towards magnetism, its electrical conductivity, biological functions, and therapeutic uses; whilst the pigments, stains, and mordants produced from it do not concern us here.

Iron chemically pure can only at present be produced by electro-deposition, and is almost unknown in the arts: but so, practically, are alloys of iron with other metals. Small quantities of aluminium, manganese, nickel, chromium, wolfram, and even gold and silver, have been experimentally

added, or may be accidentally present, some of which confer remarkable properties ; but the truly valuable alloy of iron is that with carbon, which converts it, under certain conditions, into steel. The presence of silicon, phosphorus, and sulphur also considerably affects its quality, the latter especially being usually injurious.

It may be that artists at the present day would seldom select iron as the best material in which to execute any purely artistic conception, and when we find great artistic skill lavished upon it in the past, it usually proves to have been from necessity rather than choice. The most exalted prince, like the humblest man-at-arms, found it expedient to don steel in battle, but in ages of luxury common steel would not be worn by the magnifico, unless wrought by a Cellini until it rivalled gold in preciousness. We certainly meet with iron crowns, iron crosses, and iron jewels ; but the material is here intended to symbolise power and strength, or grim earnest, and this symbolism is usually implied when the metal is put to such inapposite uses. Occasionally we may find a statue or a throne carved in iron, as a sculptor would sometimes carve in porphyry, but the use of iron and cold steel has in all ages been habitually associated with strength and with menace, too often with suffering and death. Thus, when we find art bestowed on iron, it is almost invariably where the strength of the material serves an end ; and, though the sense of utility may be sometimes obscured in the lavishness of the decoration, the most admirable works in iron are precisely those which show most distinctly the purpose they are to serve.

But to form any really adequate conception of the capabilities of iron, we must turn to works in which art, in the restricted sense, has no place whatever. It is only in such that its true power and strength at the present day are exhibited, and that it is seen to stand out among metals as a

Colossus among pigmies. In the roaring furnace, the rushing train, and the leviathan steamship we have manifestations of its destiny ; for, having laid as a dormant seed in the Bronze Age, and a baby in the so-called Iron Age, it suddenly burst in the Victorian era into a manhood absolutely astounding in its strength and vigour. For we build our ships and engines of iron, the skeletons of our houses, our bridges, and our weapons ; and nearly everything we use or wear is directly manipulated by its touch. The very ground and air of our great manufacturing centres seem to pulsate with the masses of iron and steel in motion, and in our great cities iron spreads its wire meshes above our heads like a vast web, and the hidden pipes ramify beneath our feet like the huge mycelia of a gigantic fungus. More than sixty million tons of iron or steel must be absorbed in railway lines, from which six hundred tons must be ground off every day and dissipated as impalpable powder. We are exporting iron to the value of several millions sterling a year ; and with stupendous and ever-increasing engineering works, absorbing iron individually by the hundred thousand tons, it is well that, unlike coal, the raw material is practically inexhaustible. Should attempts be made hereafter to illustrate the uses of iron in England in the twentieth century, as adequately as the Naples Museum illustrates its use in the first, a large space indeed will be required, for the present era will be remembered for the extraordinary development of the use of iron and steel, when all else concerning it is, perhaps, forgotten.

No study abounds in the marvellous like that of metallurgy, and no other branch of science presents us at every turn with such totally unexpected, and in many cases inexplicable, results. The old idea of the transmutation of metals was, no doubt, induced by some of these, and is not merely an idle dream of the alchemist. The spectroscope has more than hinted that some of the metals may not be the elementary

substances they seem, but compounds, only to be disassociated by methods of an intensity which it has not yet been possible to apply. Metals exist, without any known change in composition, in widely different states. Certain forms of lead and copper, pure though they be, oxidise with great rapidity in air, while ordinary sheet lead or copper does not. Ingots of tin, exposed to severe cold, have fallen to powder ; and many metals, including iron, on being released from an amalgam of mercury, are left in such an extraordinary state that they take fire.

But the most remarkable changes in the properties of metals are effected by the addition, sometimes, of even the faintest trace of alloy. A thousandth, or even a ten-thousandth, part of antimony suffices to ruin copper for commercial purposes ; a thousandth part of bismuth almost destroys its conductivity ; and a five-hundredth part of bismuth in gold causes it to crumble under pressure. No metal is more susceptible than iron to such influences ; and one of these mysterious and striking changes, induced by an apparently altogether inadequate amount of alloy, is the condition of iron known as steel. The addition of but three-fourths per cent. of carbon to pure iron will increase its weight-carrying power from nineteen tons per square inch to twenty-eight or thirty tons, and but an extra one per cent. doubles this capacity to sixty tons per square inch. How and why such minute quantities of carbon should confer such properties is even now but very imperfectly known, but science can at least apportion the exact amount requisite to produce steel adapted to different purposes. Thus, while two-tenths per cent. will fit steel excellently for the Forth Bridge, it requires eight-tenths to render it fit for cutlery. Nature, moreover, indicates the quality for us by causing the surface to assume a blue, straw, or mottled colour, according to the temper. The value to us of this mere added pinch of charcoal may be

imagined from the fact that £120,000 was estimated some years since to be saved by it every week in the replenishment of railway lines alone. Additions of aluminium, chromium, manganese, and tungsten also produce modifications of hardness, the value of which is scarcely yet known. Cast iron is the crude metal derived from the smelting furnace and imperfectly freed from impurity ; and, though it happens to be a nearly identical alloy of iron with carbon, has almost opposite properties to those of steel. It contains from two to five per cent. of carbon, the different proportions conferring hardness, softness, and closeness of grain. In art, great fluidity in the molten metal is of more consequence than strength, and this can be obtained through a relatively high percentage of phosphorus. Discoveries, such as that the twentieth part of one per cent. of aluminium in molten wrought iron reduces the fusing point so that the most intricate castings can be produced with ease, and the process of annealing castings in oil, by which the carbon is absorbed and the iron rendered malleable, should greatly facilitate its artistic use in the future. Its proper use in art is, like that of bronze, of which it is an inexpensive substitute, most appropriate when on a grand scale.

Wrought iron, however, is the purest form of the metal, and is that with which we are mainly concerned.

The presence of the vapour of iron shows that the metal is an important constituent of the sun and of most of the heavenly bodies. It is no less common on earth—how common few adequately realise. The vegetable mould, the clay, and the gravel of our soils owe their colour mainly to it, and the vast majority of rocks are impregnated with it ; for iron, unlike the more precious metals, is rarely found in a native or pure state. The ores are, as a rule, dull and earthy, and it is only when crystalline that they present a brilliantly metallic or attractive appearance. We derive our iron almost

wholly from stratified sedimentary rocks instead of from crystalline rocks, which means that it is not in its original condition, but has been extracted from older rocks, and sorted and redeposited by the agency of water. Our supply is consequently not limited to rocks of any particular geological period, and we can use the ores indifferently, whether formed millions of years ago or within the lives of living people. The Iron Mountain of Missouri is formed of the oldest Archæan rocks ; the rich ores of Lake Superior and of Canada belong to the remote Huronian and Laurentian periods. In Sweden and many other parts of Europe specular and magnetic iron are extensively worked from Palæozoic gneiss, mica, and hornblende slates. The spathose ores of Devonian age excavated in Germany and elsewhere, and in our own Brendon Hills, and the Weardale spathose ore of the Carboniferous, are all older than the coal ; but the richest ores in England, like the famous ores of Essen in Prussia, and most of the Belgian iron ore, occur in association with the coal measures. Thus the iron of the Forest of Dean in Gloucestershire, the Ebbw Vale and Dowlais in Wales, the renowned Low Moor and other ores of North Yorkshire, Derbyshire, Staffordshire, and Scotland, are interbedded, if not actually mixed, like the famous " Black Band," with the coal used to smelt them. Among the ores belonging to the middle ages of geology are the Cleveland, Northamptonshire, and many of the ores of France and Germany. The Tealby, and the soft, rich, purple Biscayan ores of Bilbao, are Cretaceous ; and the red ores of Antrim, and most of those of Burmah and the Deccan, belong to the newest, or Tertiary, period. Iron ores are indeed still forming by land and sea, but most rapidly in still water. In the shallow parts of Swedish lakes a stratum of four to six inches is deposited in fifteen to thirty years, constituting one of the chief supplies of the famous Swedish iron. That dissolved from soils, on coming into contact with carbonic and

Other acids produced by decaying vegetation, is extensively precipitated (as it was in the time of the coal measures) in stagnant water as limonite or bog iron, the action being denoted by the occasional rise of bubbles of carbonic acid and a thin iridescent film on the surface. The iron pans or crusts so often found at the bottom of peats and gravels are produced in this way, and were extensively smelted by the Romans, while in Canada ores of equally recent origin are still largely used at the present day.

The ores vary as much in appearance and composition as in age. We can choose for our manufacture iron in combination with oxygen, such as hæmatites, limonites, and bog ores ; or with carbon, such as clay-ironstone or spathic ore. The choice is great, for all the resources of nature's laboratory—heat, pressure, solution, precipitation—have been at work for countless ages, resulting in endless combinations with the varied elements with which the iron has been brought in contact, so that the existing varieties of oxides, carbonates, silicates, phosphates, and sulphides are almost innumerable.

The ores are thus mere rusts, so to speak, mechanically or chemically precipitated in the outer crust or shell of our earth, beneath which masses of pure metallic iron may exist.

Nearly pure native iron has been brought to the surface in the basalt lavas of those deeply seated bygone eruptions, which far surpassed in magnitude any of those witnessed by man. Lumps of native iron, up to fifty thousand pounds weight, were found on the beach of Disko Island, Greenland, which were unquestionably derived from the adjacent basalt cliffs ; whilst the samples from other bodies in space, which reach us in the form of meteorites, sufficiently prove that the abundant iron in them has not undergone changes due, with us, to the presence of oxygen. The known density of the earth, the composition of the sun, the magnetite and titaniferous iron of our lavas, go far to indicate the possibility of the existence

of masses of perhaps native iron at some depth towards the interior of the earth, if, indeed, its fluid nucleus, which possesses the rigidity of steel, is not largely composed of the perhaps still incandescent metal. The lavas we see erupted would, on this supposition, be the mere slags of a metallic nucleus, like those from a smelting furnace, the analogy being heightened by the occasional reproduction in the latter of quartz, compact silica, garnets, augite, and other natural products familiarly met with in erupted rocks.

Thus the iron, such as we find it, has been perhaps originally brought to the surface in erupted rocks, dissolved out by rain and organisms, and reprecipitated again and again, or accumulated by the abrading and sorting action of the waves.

The quantity of ore mined in this country in 1923 was nearly eleven million tons ; but the discovery of immensely rich ores of iron in almost every part of the world, and of fuel fit to reduce them, has already inaugurated a period of decline, and should lead us to prepare for the inevitable change, from the raw-product mart to the art-product mart of the world, which must ensue if we are to maintain our trading supremacy in the future.

I.

THE MANUFACTURE OF IRON, AND ITS HISTORY.

THE ores of iron are dug at no great depths, unless associated with coal, and are frequently obtained on the surface or in shallow pits and tunnels. In former times the mine was abandoned and the works removed whenever the increased difficulty in working rendered this advisable. The impure ores or accumulated rusts are brought back to the relatively pure metallic state by the process of smelting, or application of artificial heat. The operation in its simplest form, as it is still conducted by many of the savage races of Africa or semi-barbarous peoples of Asia, consists in filling a closed or partly closed oven, or even an open hearth, with the ore and charcoal. The combustion is aided by currents of air produced by bellows of skin or wood, or force-pumps, whose pistons are fashioned from bamboo or other hollow stems; or by simply fanning with palm leaves. In ancient days, in Britain and Gaul, the air-currents seem to have been obtained by selecting sufficiently exposed situations and leaving holes in the furnaces on the windward side. The remains of such mines and smelting hearths are everywhere met with, especially in wild and isolated districts furthest from seats of civilisation and agriculture; and in such situations as the remote and densely wooded valleys of the Jura they can be traced by the hundred. Down to late Roman times the reduction of iron from the ore seems to have been everywhere given over to savage or half-savage denizens of caves and woods, and to semi-barbarous races. Those familiar with our own charcoal-burners can realise how—being of

uncouth aspect, dwelling far from beaten tracks, shunning intercourse with men, working strangely with fire, appearing and disappearing into dark holes of the earth—the presence or early iron-smelters everywhere gave rise to legends of gnomes, and elves, and other mysterious beings. The tools used in obtaining the ore, even from the hardest rock, were originally of stone and wood ; and for long ages after iron was in use for weapons, the masons' and woodmen's tools, and even the blacksmiths' anvils and hammers, continued to be of stone. In Borneo timber is still felled with adzes of stone, though the natives possess beautifully finished and decorated steel weapons. It was only under the Romans that iron became common enough to be used in mining operations, and we cannot be sure until the beginning of the Christian era that a near approach was made in the fashion of the smith's tools to those of our own time. It is only at Pompeii that we find the Roman smith lacking nothing of importance that we possess, except the vice.

The iron itself reached civilised communities either in the "bloom" direct from the furnace, or more commonly as shaped ingots light enough to be easy of transport ; and in this state it formed, like gold and silver, a current article of barter. The smiths who worked these up were, in Gaul, either important citizens or formed separate and honoured communities. The discoveries at Bibracte show an entire town given over to the craft, the members of the guild being buried, like warriors, with their implements around them.

One of the most primitive of the furnaces for the reduction of the ore was still in use in India when described by Dr. John Percy, the metallurgist. It consists of a hearth two to four feet high, set up against a rock, with three sides, fashioned of carefully dried clay, in which are two holes for the earthen pipes or tuyers conveying the blast, and another on the opposite side for the removal of cinder. It is lighted

with charcoal, and fed with layers of ore and baskets of fuel until the full charge is reached. The bellows are worked the whole time, and at the end of four to six hours a small mass of malleable iron results, and, if sufficiently hot, is at once hammered into a bloom. There is no division of labour, and the smelters are itinerant, going from village to village, and setting up their furnace wherever a demand exists and a supply of iron and charcoal can be obtained. The heat is not sufficient in any of the more primitive furnaces actually to liquefy the iron, but it is brought into a pasty lump, sufficiently free from impurity to be at once malleable. Of the many forms of furnace in which malleable blooms were directly produced, one is still in use in remote spots in Europe, and is distinguished as the Catalan. This is a rectangular hearth in a permanent building without a chimney, but with a hole left in the roof, and employs about ten men. The furnace is heated with a layer of charcoal about eighteen inches deep and almost reaching the tuyer; and the charge is made up and renewed with alternate layers of sifted ore and fuel. The blast, produced by manual labour until the seventeenth century, is now obtained by the downward suction of air in a falling column of water; and it is directed on to, instead of through, the incandescent mass. Six hours after the blast is turned on, the iron is found separated, and is manipulated until it coalesces into one lump at the bottom; this is then lifted over the edge of the furnace by levers, and is ready for hammering into shape under the helve hammers close at hand. Until these formed part of the plant of European ironworks, the rude labour of fashioning the object direct from the ingot or bloom fell directly on the smith. The hammers weighed from 1,200 to 1,500, and even 2,500 lbs., and were worked by a rough cog-wheel driven by water power. Their use was to beat the rough bloom into bars on a slightly tapering anvil, thus relieving the smith of the most laborious

part of his task. They were very common in Surrey and Sussex, the name "hammer-pond" still denoting, in many places, the artificial pond which supplied the water. The furnace-masters who smelted, and the forge-master who beat the bars out by mechanical means, became distinct callings in England, and had nothing to do with the smith who produced the finished work. Little is actually known of the process of manufacture until later times, when an account of the ironworks in the Forest of Dean was communicated by Henry Poole to the Royal Society in 1676, in which, after describing how the pig iron was taken from the high-blast furnace to the open-hearth charcoal finery, and was softened and worked into a lump, he continues, "this they take out, and giving it a few strokes with their sledges, they carry it to a great weighty hammer, raised likewise by the motion of a water-wheel, where, applying it dexterously to the blows, they presently beat it out into a thick short square. This they put into the finery again, and, heating it red hot, they work it out under the same hammer till it comes into the shape of a bar in the middle with two square knobs at the ends. Last of all they give it other heatings in the chafery, and more workings under the hammer, till they have brought their bars into several shapes and sizes, in which fashion they expose them to sale." The existence of slitting and rolling mills at a later period is shown in the account of the manufacture of iron in 1725, reprinted in the *Journal of the Iron and Steel Institute* for 1885, from which we learn that the bars were called "palasades." The finished bars were classified as "merchant bars" and "mill bars," the latter being subsequently passed through the slitting and rolling mills, where they were reduced to nail rods or thin plates. These latter mills were worked by water power to save the expense of charcoal and human labour. The establishments in many cases only produced forty tons of iron per annum, and the

largest in England produced no more than six hundred and fifty tons. No doubt the excellence of its quality in mediæval times was chiefly due to the subsequent manipulation it underwent in the smithy.

In estimating ancient work, we must remember that, down to perhaps the fourteenth century, iron could not be bought by the smith in the finished bar ; and that down to perhaps the seventeenth century the bars that came into his hands were probably at best rudely fashioned and not available to be cut up and used without the bestowal of labour, like the bars from the rolling mills at the present day. The aversion to straight bars seen in the oldest smiths' work was probably due to the fact that perhaps the most difficult task that could be set was to handle and beat out a long and heavy ingot into a bar with mathematically true angles.

The erection of a shaft over the Catalan forge, by increasing its draught, converted it into a blast furnace, in which the iron could be liquefied and run off into moulds. This liquefaction marks one of the most momentous periods in the history of ironworking, for " cast iron " produced in this manner differs in its properties as much from " wrought iron " as if it were a distinct metal. Thus " white " cast iron, which contains most carbon, is fine-grained and brittle, and so hard that it sometimes cuts like a diamond ; the " mottled " kind is coarse-grained and hard ; and the " grey " assimilates most to malleable iron, being softer and rather tough. The step was so obvious that we can scarcely believe that it was not taken until late mediæval times. Dr. Percy, indeed, regarded it as not improbable that cast iron was first intentionally produced in China, perhaps at a very remote period ; and a passage in Aristotle renders it likely that, in the fourth century B.C., the Greeks knew that iron could be liquefied by heat. Theodorus, a Samian, has been credited with being the discoverer of the art of casting statues in iron, several of which

are mentioned by Greek and Latin writers. Lastly, M. Liger, in his remarkable work, *La Ferromnerie*, has brought forward evidence to show that iron was produced in blast furnaces all through the Roman, and even the Greek, period, and that it was run into pigs at the pit's mouth and sold in this state, to be worked up in the centres of iron industry. He contends, indeed, that the same process was employed in Gaul and even in Britain ; but the total absence of any objects in cast iron of great antiquity is strong evidence against its use. The cast iron tombstone at Burwash Church, Sussex, proves, however, that the art was known, and practised, though to a very limited extent, in the Weald long prior to the date given by Percy, who considered that blast furnaces originated in the beginning of the fifteenth century at Siegen, in Prussia. The Prussian *Stückofen*, described and illustrated in the sixteenth century by George Agricola, was a Catalan forge extended upwards into a shaft ; capable of either liquefying the iron or of producing malleable blooms, by varying the proportion of ore to fuel in the charge. The blooms were divided into four or five parts by hammer and chisel, and drawn out into bars ready for use on an ordinary anvil. No great value seems to have been attached in England to the discovery of casting, for almost the only objects produced until nearly the close of the seventeenth century, except cannon and shot, were rather heavy andirons and fire-backs. The oldest really important work existing is the exterior railing of St. Paul's Cathedral, which was contracted for at the high rate of sixpence per pound, and cost £12,000. Cast iron only came into general use for such purposes at the beginning of the nineteenth century. One of the best specimens is the gate at Hyde Park Corner, produced in 1841 at a cost of £5,712. Though works of utility, rather than of art, are usually associated with the material, the openwork castings known as " Berlin " iron jewellery were produced for nearly a century

at Ilsenburg, in the Harz mountains. The manufacture was kept secret, but the bog ore, rich in silica and phosphorus, and the fine quality of the loam used for the moulds, were exceptionally favourable elements.

There will be little further occasion to speak of cast iron in the progress of our work. As long as charcoal was used as it is even yet in Sweden, malleable iron could be produced direct from the ore and in contact with the fuel by continuous working, it being unnecessary to separate the refining process from the smelting. It is improbable that early fineries turned out more than from two to four tons of metal per week, and the production of iron in England was never, in the days of charcoal, estimated at more than seventeen thousand tons per annum, and, owing to the growing scarcity of wood, fell in 1725 to a little over twelve thousand tons.

Though the first patent for smelting iron with coal was taken out in 1611, very little seems to have been actually used till the problem was solved by Abraham Darby the elder in 1713; its use still continued to be restricted, since a pamphlet, published in 1756, relates that charcoal alone was used in all the processes of manufacture up to the finished bar, but that all further work upon it to fashion it into implements was performed with pit coal.

The use of coal as a fuel leaves the pig iron too full of carbon, sulphur, and other impurities to be workable, and these have to be burnt out by the action of oxygen at a high temperature. Existing processes are therefore directed to this end, and are considerably complicated.

The ore is, as a preliminary, roasted in heaps or in kilns to free it from a part of its impurities. It is next melted in flask-shaped furnaces, which may be eighty or even a hundred feet in height. These are fed from the top with calcined ore and coke, the mixture falling on to a cone which distributes it so as to prevent clogging. Blasts of air, seven

times hotter than the boiling point of water, are blown in from the base. The iron and the earthy impurities alike melt in presence of the intense heat, and trickle in a ceaseless stream to the bottom, limestone or clay being often added to combine with the impurities, so that the mixture may become more rapidly fusible. The liquid iron, being the heaviest, forms a substratum, and the slag floats upon it, so that they are drawn off at different levels, the one being a glassy waste product, still but imperfectly utilised ; while the other is run out into open sand-moulds and left to consolidate into pigs, the gutters in the sand bearing an imperfect resemblance to a sow suckling her pigs. These pigs are rough bars of iron about three feet long and four inches in diameter, and are in condition for use in the foundry. The furnace is kept in continuous action until it needs repair, and will contain from thirty to forty thousand cubic feet, so that the operations are on a Cyclopean scale. To bring them to their present perfection the brightest intellects have been ceaselessly exercised, and reams of patents taken out, the result being that where eight tons of coke were required to produce a ton of iron in the time of our fathers, one ton can be made to suffice now ; while so simple a matter as heating the blast with waste gas has saved a million tons of coal in the Cleveland district alone.

About seven and a half million tons of pig iron are being produced annually, and for the production of cast iron the process stops at this point ; but for wrought iron a purer quality is required. For this it is puddled, an invention first patented in 1784, which means that it is boiled and stirred upon a hearth, or in a chamber, until all but mere traces of its impurities are burnt out by oxygen from the air, or from rusty cinder added during the process. The iron leaves the puddling furnace as a spongy, fiery, and dripping mass, and is hurried to the squeezers, which are steam-hammers, or

other mechanical contrivances to press out the cinder and squeeze the metal into blooms. This is the process formerly called "shingling," for which the lever or tilt, and helve hammers worked by water power, were used, until the introduction of the stamp-hammer with vertical action, and particularly of the Nasmyth hammer in 1842. The blooms, being reheated, are put under the rolling-mills, which draw them into puddle bars, and these are again rolled until they acquire the merchantable form of bar iron. In these processes about four hundred and fifty tons of coal are consumed to the hundred tons of bar iron; the result being that the iron has become soft, fibrous, and tough, instead of brittle and granular—the "wrought iron" of commerce, of which some seven and a half million tons are now put annually on the market.

Steel, the third of the chief merchantable conditions of iron, is in composition a connecting link between "cast" and "wrought" iron. While resembling cast iron in containing carbon, it differs from it in being a carefully purified, malleable iron, to which a definite proportion of carbon has subsequently been added, the amount varying from the fraction one-fifth to one per cent., according to whether the result is required to be mild or steely in quality.

It is difficult, or rather impossible, to trace its origin, for the early references to it merely means a steely quality of iron produced in the bloom, or iron hardened by rapid cooling, and perhaps by tempering. The fact that hard rocks could be carved has continually been adduced as proof that steel was known to nations of antiquity, but no evidence of any value has ever been brought forward to support this proposition. A manufacture of something like steel is described by Lieh Tzu, a Chinese writer about 400 B.C., when Aristotle also described a method of converting iron into steel by melting and refining. The most celebrated steel of antiquity was, however, the Indian wootz, which had a world-wide reputation,

and was made from iron mixed with finely chopped wood and heated for three or four hours in small closed crucibles. The Chinese method, which appears the one practised in Greece and in mediæval Europe, was to melt some iron with a flux in a crucible, and to immerse and boil pieces of wrought iron in it with charcoal, for several hours, until the requisite amount of carbon had been absorbed. The process was repeated twice or more, the iron being withdrawn and well hammered each time, and plunged while hot into cold water. English steel was, until quite recently, all made by the cementation process, which consisted in packing pieces of bar iron with powdered charcoal in little fire-clay or iron boxes, and keeping them at a red heat for a week or two, during which the iron became unequally impregnated with carbon vapour. Uniform quality was obtained by breaking the bars into small pieces, judging and sorting them by the eye, and remelting the lots in crucibles. The quality, which was uncertain, chiefly depended upon a further process—that of heating the article to redness and quenching it in cold water to harden it, and then tempering the hardness by careful reheating until it became fitted to cut either metal or wood, or elastic enough for springs. The highest degree of tenacity was obtained by heating to a dull red and simply chilling rapidly in oil. The manufacture was empirical, and it was not known till 1781 that the properties of steel were dependent on the percentage of carbon present. Its use was a luxury and untrustworthy for large masses, until the introduction, about seventy years ago, of rapid steel-making processes by Bessemer and by Siemens. These have entirely revolutionised the industry, increasing the production in England to over eight million tons annually, while that of Germany is nine and a half millions. The United States manufacture the prodigious quantity of close upon twenty million tons annually.

The Bessemer process consists in melting the pig iron in a huge flask, and blowing superheated air violently through it, until every trace of impurity is burnt out. To the resultant almost pure iron the precise amount of carbon and manganese required is added by mixing "*Spiegeleisen*," which is a carefully prepared iron containing the requisite alloys. The introduced carbon sometimes acts on the mass of iron oxide with almost explosive violence, and an impressive pyrotechnic display results ; the peculiar roar of the blast is lulled, lambent greenish flames play over the mouth of the gigantic flask, which bends over as if its task were accomplished, and delivers its contents in a dazzling flow of silvery whiteness.

The rivalry of nations and their ceaseless armaments necessitate the use of ingots of forty tons weight for armour plating, and the Italians have even produced, in their works at Terni, at a single casting a mass of steel weighing a thousand tons, in the form of an anvil. Modern ships and large buildings are practically built of steel.

The Forest of Dean and the Weald of Sussex were formerly our "black countries," and contributed their share to the greatness of our country ; though destined, their task accomplished, to revert to green parks and meadows. The seat of the iron and steel manufacture, deserting the forests, migrated to the coal fields in Scotland, Yorkshire, the Midlands and South Wales, where it will remain till some far distant day when the coal is exhausted.

II.

THE EARLY HISTORY OF IRONWORK
DOWN TO THE CHRISTIAN ERA.

THE inquiry into the origin of the use of iron is a purely academic one. Iron rusts so rapidly that the delicate gold enrichments of a sword or cap may be exhumed in perfect preservation, whilst the blade or helm is only traceable in a trail of rust. But though the great bulk of the objects in iron belonging to remote antiquity have totally disappeared, yet in no instance are we justified in assuming that iron implements have been in use where neither traces nor records of such exist. The evidence of the objects themselves, as well as of tradition, leaves no doubt whatever that the knowledge of gold and of copper preceded, in a general way, that of iron; and we find that any extensive use of the latter implied, as a rule, a high degree of civilisation. The fact that the use of iron is nearly always found to be coeval with the most ancient written history has been advanced as proof of the contrary, but it can prove nothing more than that the art of working iron and the art of writing language are two stages in the progress of civilisation which have often been reached concurrently. A general use of iron is indeed seldom found to antedate history or human tradition; and we can nowhere regard iron weapons or tools, as we can bronze or stone, as prehistoric, except in a restricted and local sense. Whenever the superficial deposits of countries in which the works of man are preserved have been scientifically and at all exhaustively explored, we are at once aware of long periods about which history is wholly silent, in which the use of iron

was practically unknown ; and even in the traditions of some of the great civilisations of antiquity we get unmistakable hints that the age of bronze was too recent to have been wholly forgotten. The first impulse of man would be to arm himself and make use of implements and weapons of stone, wood, and bone ; and the Stone Ages, when the use of metal was practically unknown, are shown by the most unequivocal evidence to have been of enormous duration. The proficiency attained by the prehistoric inhabitants of Europe in the use of stone weapons, in which those of our own island fully shared, must have been prodigious, for they fought and slew the mammoth and the woolly rhinoceros, the bison and the aurochs. An infinitely shorter period in which use was made of copper or its alloy, bronze, seems invariably to have preceded the use of iron. Only those countries which are the home of the advanced scientific culture of to-day have yet been regularly surveyed and examined, and in these we find that the Stone, the Bronze, and the Iron Ages succeeded each other as inevitably as the night and the dawn precede the day. Yet there could no more have been a universal Bronze or Iron Age than a universal age of infants or of grown men, for races have been in the past like individuals, some in infancy, whilst others are in decay. Thus the use of iron was known three thousand or even four thousand years ago where civilisation existed ; whilst the races of Australia, Polynesia, and the Oceanic isles were in their age of stone when they first came in contact with Europeans ; and in the whole American continent the most powerful civilisations had alone reached the age of copper and bronze.

In tracing the history of iron we should be peculiarly cautious in accepting remote traditions of a knowledge of its existence as proof of a knowledge of its manufacture and use. Interesting bodies called meteorites are continually falling on the earth from space, and though the vast mass of those which enter our atmosphere are entirely dissipated by friction, and

only reach us imperceptibly as cosmic dust, yet the fall of hundreds of solid masses has actually been witnessed. Those which have thus run the gauntlet reach us as remnants, seared, scorched, and wasted, but priceless lumps, which are occasionally composed of almost pure metallic iron. Now, the fall of a heated mass, crashing apparently with terrific violence, whether as a bolt from the blue by day, or a hissing, blazing meteor by night, is a startling event, even when witnessed in these newspaper days; and how much more awe-inspiring and miraculous would it have appeared in the dark age of superstition! It was inevitable that such falls should have attracted notice from the very earliest periods of human history,* and the stones, when recovered, been deemed fit objects of idolatry; like one which fell in India as recently as August, 1884, which was decked with flowers and daily anointed with much ceremonial.† No metal except iron ever reaches us in this way direct from the sky, and this fact alone must have invested it with a singular and mystic interest, before ever its utility to man was perceived. Thus we find in an age of copper, ornaments and pieces of meteoric iron placed on the altars of the Turner Mounds of Ohio. Now, some of the meteorites of native iron—called siderites, to distinguish them from the stony meteorites—are of such magnitude that they could not have failed to excite attention, an exceptionally large mass in the Argentine Republic being said to contain thirty thousand pounds of solid malleable iron, whilst many others found in America and Australia are several thousand pounds in weight. The fact that none of any size have been discovered

* No less than sixteen falls are recorded in Chinese literature prior to A.D. 333. The earliest fall recorded in Europe happened in Crete, 1478 B.C.; a fall in 705 B.C. is noted by Plutarch; another in 654 B.C. by Livy, and so on.

† A black conical stone which fell in Phrygia was worshipped as Cybele, the mother of the gods, by the Phœnicians; and the Diana of the Ephesians and a Venus at Cyprus were, there is reason to believe, like the stone of Mecca, of the same nature.

in countries of ancient civilisation in the Old World is very like proof that they were utilised, or not neglected ; and if a doubt could be entertained as to whether they existed as abundantly in our hemisphere, it is disposed of by the fact that seven of the nine siderites actually seen to fall fell in the Old World. The most ancient name for iron, the Egyptian, signifies, in fact, " stone of heaven," or " stone of the sky," and the Greek name seems to betoken a not dissimilar derivation. Though meteoric iron is not readily malleable, owing to the presence of phosphorus, nickel, and cobalt, the Mexicans, the Indians of La Plata, the Esquimaux, and other semi-barbarous peoples contrived to use it when they were totally unacquainted with any means of obtaining iron from the ore. Analyses of the iron of prehistoric weapons have disclosed that many contain an appreciable percentage of nickel, an alloy that is not obtainable by smelting any known ores, but which is invariably present in siderites. It is, moreover, actually recorded that sabres and poignards were made in Persia from a siderite which fell in 1620. It is thus hardly conceivable that peoples of remote antiquity should have been totally unacquainted with the existence of iron or failed to recognise at least its hæmatite ores, or to extract the metal from them.

Many nations share the tradition that the discovery of the production of iron from the ore by smelting resulted from forest fires. Immeasurably the most ancient of these, if we could trust Chinese chronology, is found in the Book of Historical Documents, in which Fu Hsi, some 3200 years B.C., accidentally smelted iron out of a brown earth when clearing away forests, and fashioned spear-heads from it, with which he taught his people to hunt and fish. The Chinese, however, so exaggerate the antiquity of their industries, that their dates, previous to Confucius, are quite unreliable. We must thus take for what it may be worth the date—equivalent to

2000 B.C.—of a tribute list, in which words occur translated as “hard” and “soft iron,” in company with “stone” for making arrow-heads; and also the story that soon after this date iron swords superseded those of bronze. Hardly any further mention of iron is found in Chinese annals until Lieh Tzu, 400 B.C., describes the methods in use for making both iron and steel. There is, however, no reason to doubt that the industry is at least as old in China as elsewhere, and that it was practised almost universally in Asia in prehistoric times. That the Chinese excelled in it may equally be believed, though scarcely any early specimens of their ironwork are to be seen in Europe, for they still practise an art unknown elsewhere—that of welding patches into their thin cast-iron vessels.

The working of iron in India also dates back to a remote antiquity, though preceded, as in Europe, by ages of stone and bronze; for the Aryan colonisation found the indigenous races already acquainted with its production. The partial conquest of India by the Aryans commenced somewhere about 1500 B.C., and it is clear from the Rig-Veda that they brought a well-developed iron industry with them. The celebrated wootz, from which the Damascus blades were probably made, is of unknown antiquity, but the thirty pounds of iron presented by Porus to Alexander shows that he possessed iron, or probably steel, which was regarded as of no ordinary value. Steel, or iron of a very steely quality, appears to have been largely exported from the shores of the Ganges by Western nations, and the *sericum ferrum*, said by Pliny to have been the best imported into Rome, sometimes supposed to be Chinese, was very possibly wootz from India. There are some iron implements in the British Museum from tumuli at Wurree Gaon, of unknown antiquity, which have been supposed by their discoverer to be almost as old as the Aryan conquest.

Though it is abundantly evident that Egypt cannot be ranked as a country making any extensive use of iron until the last centuries of its autonomy, the Egyptians were acquainted with it from an early period, and it was easily obtainable. It was not apparently used for tools. The fact that they were able to carve granite and syenite has been regarded as evidence of the use of iron as far back as about 3000 B.C., but the Mexican and Peruvian civilisations quarried and even carved porphyry, greenstone, diorite, basalt, and gabbro on a very extensive scale, and we have the most positive statements that when discovered they were ignorant of the use of iron. The precise accounts of their weapons and implements of bronze, jade, and obsidian, and their thick, quilted, defensive armour, leave no doubt on this point. No word for "iron" is known to have been in use, no iron has been discovered in their tombs, and neither the remains nor the tradition of ironworking among them. Like several other peoples of America, they made use of what meteoric iron they became possessed of, and highly prized it; but their quarrying and stoneworking is circumstantially described as having been effected with wood and stone tools, which latter were found to cut through even iron with ease. We should find it difficult to kindle fire with two sticks, or to accomplish many operations which uncivilised man can readily perform; and there is nothing inherently improbable in the account that stone was carved with still harder stone, shaped for the purpose and wielded by practised hands. If the Peruvians and Mexicans could carve basalt and granite without the use of steel, it would be futile to deny the same skill to the Egyptians; and Mr. Bauermann, a practised observer, most distinctly stated that the inscriptions in the neighbourhood of the copper and turquoise mines at Wady Meghara were, up to the last, dressed with flints. The single plate of hoop iron found seventy years since near the mouth of an air-shaft of the Great Pyramid,

and now in the British Museum, has frequently been cited as evidence of the use of iron during its building ; but the find is so entirely exceptional, the shape of the iron so useless for any building purpose, and it is so fresh-looking that, in spite of its discoverer having certified to its removal from a position in which he believed it could only have been placed contemporaneously with the building, we must wait further evidence before regarding the use of iron in the fourth dynasty, perhaps some three thousand years B.C., as an established fact. The pyramid has been stripped and ransacked for ages by people with iron in their hands, and instances abound showing how easy it is for objects of metal, such as a broken sword-blade discarded or lost, to find their way into what appear quite inaccessible positions. There is nothing else to lead us to believe that iron was in use until fully a thousand years later ; and cutlery, weapons, and carpenters' tools were of copper or bronze. Small objects of iron are said to begin to appear in tombs and on mummies supposed to date back to 2000 B.C. ; and it seems quite certain that iron had come into at least partial use by the eighteenth dynasty—perhaps about 1500 B.C. Weapons are then depicted, sometimes in red and sometimes in green and in blue, while an inscription records that thirteen basins of iron came into the possession of Thothmes III. among the spoils of Ouan. Iron cramps found in the walls of Heliopolis may be of later date, but in the nineteenth dynasty the chariot of Rameses II. was of iron, and his bronzes are found with iron core wires. This brings us to about the date of the Exodus, and it is significant to find the opinion expressed by such an authority as Sir John Evans that the Israelites were then unacquainted with iron. The painting, representing a heap from which flames are issuing, of the date of Thothmes, with a man on either side working bellows, often supposed to be a forge, more probably depicts gold or copper smelting. Bauermann found only

hammers and tools of stone and wood in the mines of Wady Meghara, which were the most important held by the Egyptians, and representations of metal-working show stone and copper anvils and hammers, but never iron. Although Mr. Hartland has reported the existence of remains of vast iron-works in this neighbourhood, situated on some hills at a place called Surabit-el-Khadin, it is probable that the undoubted evidences of great antiquity belonging to the copper and turquoise mines have been unduly appropriated to these. The bulk of the objects in iron recovered in Egypt date under any circumstances from the Roman occupation. Under the Ptolemies statues were made of iron, and even its magnetic properties were understood, for Pliny relates that it was proposed to make the roof of the burial-vault of Arsinoë of lode-stone, so that her effigy might remain suspended without support.

The use of iron was not confined to the Egyptians in Africa, for their inscriptions tell that the Ethiopians, who were little better than savages, possessed iron; and their troops in the army of Xerxes wore helmets of iron and bronze. In some districts of Africa iron occurs in a condition which enables it to be wrought by the most primitive methods, and its production seems all but universal among the uncivilised tribes of the interior. It is still frequently worked with stone hammers and anvils, and numerous practices survive which would no doubt well illustrate the working of iron in the remotest antiquity. As in ancient Chaldea, iron rings and bracelets are much worn by many of the native races.

Chaldea may have preceded Egypt in civilisation, and an early use of iron has been inferred in both instances on analogous grounds. It has been assumed that engraved seals, thought to date back to 1600 B.C., were cut with iron or steel gravers. Iron was used first in Babylon 1500 to 1000 B.C., where bronze continued to be employed on the largest scale, until

the time of Nebuchadrezzar II. (d. 561 B.C.), when bolts and hangings of gates and the cramps of the stone bridge across the Euphrates were of iron. The Chaldeans made the most limited use of the metal, and little else than rings have been found, which appear to have been symbolic. It was more extensively used by the Assyrians, who were skilled metallurgists, and exported iron from Nineveh to Egypt. We know nothing definite about it earlier than the inscription of Tiglath Pileser I., discovered at Nineveh, which states that iron formed part of the spoils of Northern Syria about 1200 B.C. Others show that under Sardanapalus III., about 900 B.C., large quantities of iron were included in the treasury of princes, as much as five thousand talents having been captured at one time in Damascus. Though apparently scarcer than bronze, both this king and Sennacherib covered the framework of buildings and fortifications with it. The very interesting discovery in the palace of Khorsabad, built by Shalmaneser in the eighth century B.C., of a hundred and thirty thousand pounds weight of iron in a room supposed to have been the treasury, shows that iron was stored in rough wedge-shaped ingots, with holes through them to facilitate transport. These may, like many of the iron objects brought from Nineveh, belong to the Sassanian period, but the great iron bolt in the British Museum, which barred one of the bronze gates, must be genuine Assyrian. One among the conical helmets there is but slightly different from the form represented in the bas-reliefs of Sennacherib, and though in the most advanced state of decay, shows that the lines so invariably present on them represent bronze fillets. It may be of the time of the destruction of Nineveh, 606 B.C., and seems to have been beaten out of one piece, like the morions of the Renaissance, and is thus of more difficult work than the Sassanian helmets, of several pieces riveted together, found in the same locality. Layard also states that he found innumerable plates of iron, two or

three inches long, shaped like those of the scale armour in the bas-reliefs, but the ring armour actually brought away seems undoubtedly Sassanian. Iron was used, as in other countries, for strengthening objects of bronze, such as the handles of shields, the rings and feet of tripods, the legs of couches, etc.

The relative frequency of the use of iron and bronze among the Hebrews may be gathered from the fact that "iron" occurs only thirteen times in the Pentateuch, whilst "bronze" is mentioned forty-four. The Philistines are stated to have deprived the Israelites of their smiths, and in the time of David, 1000 B.C., iron was in somewhat general use. The iron bedstead of Og has been interpreted as a bier fashioned of black basalt rock; but Ezekiel speaks of an iron pot, in the sixth century B.C., when such utensils were almost everywhere of bronze. The reference in Ecclesiasticus xxxviii. 28 (dating from about 180 B.C.) suggests a ready acquaintance with the artistic working of iron. The Chalybes of Pontus, from whom the Greek and Latin words for "steel" were derived, appear to have been a race of smiths, and produced a metal so renowned for weapons that it is conjectured to have been steel; this they exported as tribute to Nineveh. Their part of Pontus has always been regarded by classic writers as the mother-country of the iron industry, which even now is everywhere carried on by the inhabitants in something like its old form. Chalybon, a town of Syria, was also the centre of an iron district, and iron vessels formed part of its tribute to Thothmes III. and the spoils of Tiglath Pileser I. The Phœnicians equally claimed the discovery of the art of working in iron, paid tribute of iron vessels to Egypt, and traded largely in it, especially with Carthage. They possessed, in common with other peoples of Asia, wooden statues covered with iron plates. In Homer we read that the Sidonians were incomparable chasers of iron, and a considerable trade in that metal passed through Tyre down to the time of its destruction. Strabo

states that the town of Cibyra, in Asia Minor, was famous for chiselled ironwork, and the Scythians appear to have used iron from very remote times, and are credited with having introduced it into Greece during the first Theban War. Yet, though the district thus appears to be the very "black country" of antiquity, the Massagetæ just to the South, according to Herodotus, and the Sarmatians to the North made no use whatever of iron.

We know nothing in this connection regarding the Medes, except that they paid a tribute of iron to the Assyrians. The Persians in the army of Xerxes, in the fifth century B.C., wore iron as well as bronze scale armour, and the swordsmiths of Meshed and the Khorasan afterwards became world-renowned. The Turanian peoples of Central Asia must also have been great iron workers, for we read that the King of Samarkand paid a tribute of iron mail and locksmiths' work to China as early as 713 B.C.

As it is conceded that iron was in use in Asia in pre-Homeric times, it is unnecessary to debate whether the evidence as to its use by the Greeks before Homer's time is or is not conclusive; Hesiod, who was almost his contemporary, arms the gods with iron, giving to Hercules a helmet of steel called "adamas." He also speaks of adamantine chains and bars of the ports, but writes as an eye-witness of the passage from the Bronze to the Iron Age, lamenting the evils that the fatal discovery is destined to inflict on the human race. The Parian Chronicle, among many legendary dates, records the first discovery of iron, in Mount Ida, Crete, in the year 1432 B.C., in the reign of Minos, after the date of Cadmus, Danaus, and the Amphictyonic League. This shows that a rooted tradition existed of a time when iron was unknown to Greek civilisation, and that it was introduced within what may be considered their historic period. This is confirmed by the important excavations at Mycenæ, where a few ornaments of

iron, such as finger-rings, were discovered in some of the later graves. Iron was only represented in Troy and at Hissarlik by decomposed nodules called "sling-bullets," doubtless of iron ore, like the plummets so commonly found among relics of the moundbuilders in America; and by a small knife assigned to the Alexandrian period; whilst the peculiar keys and knives found in the former were considered not to be older than the fifth century B.C. Excavations in Cyprus also confirm the existence of a copper or bronze age, when iron was unknown. We glean from Homer that its use was exceptional, the most remarkable of the objects mentioned being the mace of Areithöus and the arrow of Pandarus, both, significantly enough, presents from the gods; the axle-tree of Juno's chariot, regarded as a unique object; the twenty funeral axes of Patroclus; and the large ingot of Achilles. Iron seems to have been used, much as in Assyria, for the cores of objects of bronze, such as tripods, the handles of bronze shields, and inlays; but since the *Iliad*, as handed down, probably contains the work of various hands and ages, we may not unreservedly accept all its technical references. Bronze weapons had not fallen wholly into disuse in Greece down to 400 B.C., since Plato states that both bronze and iron were the metals of war. From the fact that bronze continued to be everywhere in use for swords and cutlery so long after iron was introduced, it has been inferred that it could be hardened, and formed into knife and razor edges of great keenness. Whilst others who had used iron, merely regarded it for its strength, and often overlaid it with bronze and more precious metals, the Greeks recognised the beauty of the material, so that it came under the artistic influences already lavished by their sculptors on gold and bronze. Though no work of Greek art in iron has come down to us, passages in their literature indicate that they practised the arts of casting, forging, welding, embossing, polishing, inlaying, and tempering

iron. The discovery of the art of casting statues in iron is ascribed to Theodorus of Samos, who lived, according to Aristotle, in the fifth century B.C. Pliny, writing in the first century A.D., reports that the iron statues of Athamas and Hercules were still extant in Thebes. Pausanias, in the next century, was greatly struck by the representation of the combat of Hercules with the hydra in iron by Tisagoras, as well as with the heads of a lion and a wild boar in iron, consecrated to Bacchus at Pergamos. Numerous statues of cast iron at Athens and Corinth are mentioned. The discovery of the art of welding, or perhaps soldering, iron is attributed to Glaucus of Chios, 690 B.C., who is said by Pausanias to have hardened and softened the metal at will. One of his works was the openwork iron pedestal of a large silver crater-shaped vase, given by the Lydian king, Alyattes, to the temple of Minerva Pronæa at Delphi. This pedestal was constructed, according to Herodotus, of small plates of iron, beaten and joined together in so marvellous a fashion as to be worthily ranked above all the gifts to the temple at Delphi. It must have been a striking work of art, for Pausanias again describes it as shaped like a tower, tapering from the base, each side being formed of bands echeloned above each other, the highest recurved outwards, and fastened together neither by rivets nor joints, but by solder only. Hegesander again speaks of it nine hundred years after its original production, and seems to indicate that it comprised figures and foliage. The art of polishing iron by the Greeks is suggested by the words of Ezekiel in his denunciation of Tyre; and the magnificent helmet executed by Theophilus for Alexander the Great was, according to Plutarch, polished and shone like silver. The art of hardening iron by plunging it while hot into cold water is spoken of by Homer, and Sophocles compares an obstinate man to iron that has been so treated. This art was especially practised by the Corinthians, who prepared it by fusion, as

described by Aristotle, and is redescribed in Pliny's *Natural History*. Iron was extensively used by the Greeks in the construction of ships, chariots, engines of war, agricultural implements, etc., though it never seems to have been used so largely as bronze. In Sparta, however, especially, there was an iron currency, and much iron jewellery was worn.

The Romans sooner or later assimilated the arts of the Greeks, who seem to have left little further to be discovered in the manipulation of iron for the purposes of art. In the reign of Tarquin, weapons of iron were in partial use, but by a clause in the treaty with Porsenna, iron was reserved exclusively for agriculture, and remained so down to the second Punic War. In the second century B.C., during the consulate of Flaminius, iron weapons were reintroduced, and Polybius informs us that short two-edged Spanish swords of excellent temper were adopted in the army. Steel was known to them by the Greek name *chalybs*, and also *acies*. The rams of ships were fitted with iron, and an immense use was made of iron chains for engines of war, ships' cables, and for securing prisoners. It is a singular fact, however, that the Romans did not themselves manufacture iron until a very late period, but procured it from Etruria, Norica, Styria, and many other places.

Roman metalwork is probably but a continuation of that of Greece, with something less of simplicity and refinement and more of elaboration; though the brief appreciation of the intrinsic beauty of iron by the Greeks is not traceable in Roman or even in Etruscan art. The excavations at Pompeii have shown that the uses of iron in A.D. 79 were nearly identical with our own, except that little artistic use was made of it; but it must be remembered that the town never had any importance, except that conferred upon it by the beauty of its situation on the shore of the Gulf of Naples. Though placed, as it seemed, in one of the most favoured spots of the earth,

it was severely shaken by an earthquake in A.D. 63, and sixteen years later entirely buried under a layer of ash eighteen to twenty feet thick. The crest of the sunny and cultivated mount, under which it had safely nestled from its foundation, was suddenly blown miles high into the air, descending in a rain of mud and burning cinder, and barely allowing the inhabitants to escape with the most portable of their valuables. Very little in iron would have been removed, for already its position as a baser metal was defined. Innumerable, however, as are the implements, tools, etc., disinterred from Pompeii, we cannot fully gauge the use of iron by the Romans, since the age of palatial buildings and luxury had not yet reached its zenith. Thus from Pompeii we might infer the total absence of constructive ironwork in Roman architecture, yet Professor Aitchison claimed that, in the Baths of Caracalla, a large ceiling was supported on iron girders.

Of the objects actually recovered, those of chief interest to us are the iron window-bars, exactly like those still used in London basements; the iron casement windows with glass panes retained by movable buttons; and the iron grilles that separated the arena from the auditorium in the amphitheatre. The entrances to the forum appear to have been closed with iron gates, but the spot was rifled in early days, and, with the marbles, they were perhaps carried away. Grilles, called *cancelli*, though extensively used in temples, courts of law, etc., were merely of trellised bars, like the filling in of the space over the doors of the Pantheon, or as represented on the Arch of Constantine. An illustration, in Liger's *La Ferromerie*, shows a combination of trellis with a scale pattern in a door within the portcullis of one of the gates of Wiesbaden.

The more highly decorated jewel and money chests, three of which are illustrated by Liger from Pompeii, were combinations of bronze, wood, and iron, the workmanship of the latter being poor, as far as can be judged from the rusted remains.

The best, supposed to be the *arca* in which the quæstor kept the public money, is sheathed with iron fixed with brass-headed nails, like those still in use for the purpose in Naples, and lined with copper, and stood on a marble plinth. The largest measures about three by two feet and a half, but in Rome they were more considerable, since it is related that men could hide in them. In Pliny's list of ironwork, two iron vases and a chiselled table occur among the consecrated objects of Roman temples, perhaps spoils from Greece; though rings, tripods, lamps, and other partly decorative iron objects are occasionally disinterred in Pompeii. The largest and most difficult forgings were undoubtedly those required for offensive engines of war, particularly the beaks of vessels, one of which, in form of a ram, was recovered during the dredging of Genoa harbour. Iron and steel armour was extensively used, and may have been richly embossed, though the embossing was more probably confined to an overlay of bronze or gold.

We glean from Pliny, Strabo, Plutarch, Tacitus, Diodorus, and Cæsar, that the use of iron was general in Europe before ever its barbarian peoples came in contact with Rome. Thus the Catti possessed it in great abundance, the Germani threw iron axes attached to cords, the Cimbri wore iron breastplates and used large swords and javelins, the Gauls wore iron ring armour, and the Britons used iron bars as money; but history fails to throw any light on its origin or manufacture among these peoples. It is only through the opening of graves, and by means of other excavations and accidental discoveries, that we know that, whether in Gaul, Spain, Germany, Britain, or Italy itself, there were periods which, though prehistoric, cannot be regarded as very remote, in which all traces of weapons or implements of iron are absent. There is little to justify the assumption that its use anywhere in uncivilised Europe antedates its use in more civilised Rome. Even

Spain, the greatest metalliferous country of antiquity, whose Celtiberian swords of iron were adopted in the Roman army as early as the second Punic War, presents the most distinct evidence of a native industry in copper and silver, and the knowledge of bronze, before the discovery of iron.

The Phocæan colony of Marseilles, founded about six hundred years B.C., possessed iron-mines in Spain, and manufactured weapons from them, and it was perhaps through this circumstance that the Gauls became acquainted with the use of iron at a very early period. Long before they were subjugated by Rome, they excelled in its working; later, the industry was held in such esteem that only freemen, who formed an important corporate body, were permitted to exercise it, and these were buried with their implements, as warriors were buried with their arms. The excavations at Bibracte revealed a town given over to the working of metal where all the buildings round the *oppidum*, or centre, were smithies or foundries; in which gold, bronze, iron, and even steel were manufactured, and the surface-decoration of metals carried to a point that has hardly been surpassed. The magnitude of the iron industry is shown in the extent of the mines, which excited the attention of Cæsar, and in the prodigious quantities of slag used in the Roman roads. Tinned iron vessels, the *incoctilia* of Pliny, were imported to Rome from Gaul, Alise being celebrated for the industry, as well as for coating iron with gold and silver, so that it was difficult to recognise the original metal. The beautiful swords discovered at Alise differ remarkably in weight and ornamentation in every specimen, and are masterpieces of the smith's art, fashioned by the hammer and smooth and polished by grinding. The associated iron scabbards are smooth on one side, and richly ornamented on the other with dotted and lined, wavy, and trellised patterns, and even with animals like those on Gaulish coins. It was on the trappings of their

horses and chariots, however, that the Gauls lavished their choicest metalwork, and Pliny states that at Bourges, which rivalled Alise, chariots, at first only plated with tin and silver, came to be entirely gilt and decorated with beaten gold ornaments. A beautiful iron mask is a fine example of embossing, but still more remarkable is the claim by Liger that he detected traces of enamel on iron, and that the Gauls and Britons, as well as the Romans themselves, were able to cast in iron. That so high a degree of technical skill should have existed in a nation whose history is almost a blank, and whose swords in the second century B.C. were so soft and flexible as to lead to their discomfiture by Flaminius, is almost incredible.

To the spade of the antiquary we are indebted for relics of our own Prehistoric IRON AGE, a vague period commencing with the use of iron in Britain and ending with our first contact with the Romans, estimated to have occupied some five hundred years. These practically throw the only light on the history and development of civilisation in Britain prior to the writings of Cæsar. From the finds made during excavations it is clear that during at least a part of this long period Britons practised the arts of enamelling, casting, and embossing bronze in great perfection, their work being even in some respects distinctly superior to that of the Continent.* Our Iron Age was perhaps shorter than in Gaul, and the transition from the "Age of Bronze" to that of iron is less clear. Strange as it may appear, the overwhelming superiority of iron for weapons and implements was not realised until long after the metal itself was known, for collars and brooches

* Cæsar informs us that Britain was a seat of learning and that the Druids formed a training college for young men, teaching religion, literature, and the natural sciences as then understood. Among the gods worshipped one presided over mercantile affairs and another over inventions and manufactures, the equivalents, according to Cæsar, of Mercury and Minerva.

have been found of iron when iron weapons were unknown. Relatively few specimens of prehistoric iron are well-preserved in this country, but they comprise numerous iron swords in iron or bronze scabbards, the heads of spears or javelins, axes, knives, umbos of shields, various implements, horse trappings, parts of chariots, ornaments, and very rarely iron mirrors not inferior to those of Gaul. But incomparably the most important finds connected immediately with our subject are iron objects resembling contemporary British sword blades, but stouter and blunter. They would naturally be regarded as no more than the merchantable iron of the period, like the bars of mediæval days, ready for home consumption or export, iron being among the exports from Britain enumerated by Strabo in the time of Augustus. Mr. Reginald A. Smith of the British Museum* has, however, brought forward evidence to prove that they represent the bars of iron used as currency alluded to by Cæsar. Three weights have been found, the lengths varying from two feet six inches to two feet nine inches; the margins for a short distance at one end are hammered over to form a sort of handle, thus increasing their superficial resemblance to swords; and certain peculiarities of the hammering are said to distinguish the three different weights. By far the larger number weigh on an average twenty and a half ounces, a few about half as much, and a very few double. Roman weights corresponding with the lightest of these have been found, one of them in Wales. The fact that the iron of Sparta, the Italian As, and other primitive currencies, took the form of bars, lends support to Mr. Smith's views, which are generally accepted.

The matter is of great interest, but these bars, being unwieldy, and as a merchantable commodity in great demand like cattle, were no doubt more an article of barter than

* Proceedings of Society of Antiquaries, January 26, 1905, p. 179.

mere money tokens. The distribution of the finds, however, unmistakably points to the Forest of Dean as the seat of production and not to the Weald of Sussex, as surmised by Mr. Smith. The Forest of Dean occupies an area between the Severn and the Wye, and in its vast caverns still remain whence the Romans extracted their ore, and their ancient smelting floors and forges are still numerous. In Gloucestershire three hundred and ninety-four of the currency bars were found at Meon Hill, and one hundred and forty-seven at Bourton-on-the-Water; at Malvern, Worcestershire, three hundred; at Ham Hill, Somerset, a large number have been ploughed up; two were found in the lake-village of Glastonbury, and about thirty in camps in Dorset. Outside these western counties seven or eight were found at Maidenhead, Berks; Hants has yielded half a dozen, and Northants one. The Weald was at this time, and for long afterwards, an impenetrable forest, and the later Roman workings there are relatively scanty. It would thus be strange to take iron in large quantities across difficult country to the vicinity of the far more important, ancient, and better-known iron country in the West. It may be permissible to couple the two statements, almost in juxtaposition, of Cæsar, that the maritime provinces were inhabited by the Belgæ, and the iron came from a maritime province. The Belgæ inhabited Somerset, Wilts, Berks, and Hants, and probably the western parts of the south coast, where numerous tribes had settled. They were thus within easy access of the Forest of Dean, if they did not actually possess it. As Cæsar attributes the great skill the Gauls displayed in defending Avaricum* "to the extensive *iron* mines in their territories," no doubt "every description of mining operation was known and practised by them." This can only apply to the Belgæ who then held the great iron district of modern Belgium, between the Seine, the Marne, and the Rhine. Consequently

* The modern Bourges.

it is more than probable that the iron industry of the Forest of Dean, bordering, if not actually included in, their territories, would be carried on, or at least controlled, by the dominant and conquering Belgæ.

It was through these Belgæ, largely Germanic, who occupied the northern parts of Gaul and, differed from those to the south in manners, customs, and laws, that Cæsar first came into contact with Britons. In almost all his battles in Northern Gaul he found British auxiliaries fighting in their ranks, and he therefore resolved to invade Britain. The connection between the Belgic Gauls and their colonies was of the closest, the settlers in Britain being still called by the names of the states they came from. Cæsar speaks of twenty-seven nations, some only incidentally. A King Divitiacus, of the Suessiones, the most powerful man of all Gaul, governed not only a great part of Belgic Gaul but Britain as well. The leaders of the Bellovaci who had promoted the war with Rome fled to Britain. Commius, an Atrebatian of Britain, was made King of the Atrebates in Gaul by Cæsar, and later also of the Morini, whose territories comprised the French coasts of the Straits of Dover. All these and the Remi* had settlements in the island, but Cæsar's many enquiries about its ports and inhabitants elicited little information, though resulting in an embassy with offers of submission from several British tribes. Commius, on account of his influence, was made to accompany these on their return home. This Commius served Cæsar faithfully until the revolt under Vercingetorix, after whose final defeat he retired into exile.†

Before the invasion of Britain could be safely undertaken, the Veneti, otherwise Bretons, who monopolised the carrying

* Pottery like that of the Remi has been found at Aylesford.

† He no doubt returned to Britain and resumed his kingdom there, for he and three of his sons are commemorated on British coins dating before the Roman occupation.

trade to the island and possessed a powerful fleet, had to be dealt with. The episode presents the iron industry, probably that of Britain itself, in an important light, for the stout oak benches of their large seaworthy ships were bolted together with iron spikes as thick as a man's thumb, and the anchors were held by iron chains instead of cables. The Roman galleys, built for the war, were beaked with iron spurs or iron rams, but these were useless on account of the height and strength of the enemy's vessels. Consequently heavy falcate axes, like huge English bills or lochabers, were provided to cut the rigging and hold the vessels fast, and they were boarded amidst the confusion of their falling spars and sails. The action was fought in a dead calm, and the Veneti making no use of oars were unable to manœuvre or escape, and their fine fleet of two hundred and twenty ships was destroyed in view of Cæsar and his army. British auxiliaries took part in the action though without ships of their own. Cæsar twice invaded Britain, landing on the same spot. He describes Kent as an entirely maritime district, inhabited by the most civilised nations not differing much from Gauls. Its people were innumerable and their buildings numerous, and for the most part like those of the Gauls. As a maritime province it was inhabited, as he expressly states, by the Belgæ, and it had four kings at least. The Britains were defeated twelve miles inland, but a storm damaging Cæsar's ships, they gained a respite of twelve days, when he was confronted by Cassivelaunus, chief of a district separated from the maritime provinces by the Thames and eighty miles from the sea. He reigned over one or more of the interior provinces inhabited by aborigines. Cæsar's new foes, as he describes them, were almost naked, tattooed, and stained blue with woad, shaved, except the head and upper lip; fighting in loose order, horse and foot, but mainly from chariots. The prodigious number of these is inferred from the statement that Cassivelaunus,

with his army disbanded, retained a guard of four thousand charioteers, his most expert troops. These, like the ships of the Veneti, implied a large iron industry, for the wheel-tyres discovered in chariot burials are three feet in diameter and made of one piece of iron. The chariots had two wheels, were low or open in front, and drawn by two horses. They held an expert driver, and at least one agile warrior armed with missiles, who fought as mounted infantry. There is nothing in Cæsar's writings, nor have the burials yielded any support to the idea that the wheels were armed with scythes in the Eastern manner, the statement, a century later, by the Spanish geographer, Pomponius Mela, notwithstanding. Hence our Boadicea of the Thames Embankment is in several respects historically misleading.

The coming of Cæsar was without immediate result. The native warrior appears not far removed from the savage even two hundred and fifty years later, for he carried only a small shield and spear, and a sword girded to his naked body. Tacitus says that under Caractacus the Britons wore neither helmets nor armour, and Herodianus relating the expedition of Severus is even more explicit: "Of a breastplate or helmet they know not the use, esteeming them an impediment through the marshes. They enriched their necks and loins with iron as an evidence of wealth, instead of gold, and went naked rather than conceal the tattoos of different animals, which covered and gave a blue cast to their bodies."

Under the later Roman occupation great advances were made towards complete civilisation. Ironworking certainly underwent extensive developments, for not only the Forest of Dean, but the Weald of Kent, Weardale, Cleveland and districts to the north were opened up. The most remarkable invention for producing the "blast" discovered in Roman Britain is seen in the extensive ironworks of Lanchester in

Durham, where two tunnels were found in the side of a hill facing west, tapering and meeting in a point. If progress may be gauged from the tools and implements discovered during the systematic excavations of recent years, the Britons had little left to learn, for hardly anything is wanting, not even planes and screws.

The Roman occupation came to an end about A.D. 410, but though the legions and cohorts, made up of many nationalities, departed, the country was not otherwise depleted of inhabitants, unless the legend of the eleven thousand virgins in some dim and distorted way commemorates an exodus of the womenfolk of the legions, who, because never again heard of, were supposed to have lost their way and been massacred by the Germans, the hereditary and ever formidable foes of Rome. Meanwhile the legions of Britain had become celebrated for their valour, and their commanders had even made themselves Emperors of Rome.

The metalworking of Gaul no doubt passed to the neighbouring Franks and Goths, and from the similarity of the ornaments on the swords and scabbards found at La Tène, Tiefenau, and Hallstadt, its influence must have extended eastward as far as the Tyrol. The fragments of war-chariots and ring armour discovered at Tiefenau, near Berne, seem actually of Gallic manufacture.

That the arts of Gaul were also carried by the Goths into Denmark and Scandinavia, in the Iron Age, appears no less likely. In that new home, they were again subject to the influence of Roman art, which permeated by peaceful barter *viâ* Gotland, where thousands of Roman and Byzantine silver coins have been found. Reference to the Danish and Scandinavian handbooks shows how rapidly classic emblems and forms became assimilated and transfigured by an intensely superstitious race. The drapery, laurel wreaths, and inscriptions, which to them were meaningless, became snakes, birds,

quadrupeds, and other symbols of deep import in pagan hieromancy ; on the ancient art was grafted a set of forms and devices which, though constantly modified, were not departed from until the adoption of Christianity in the eleventh century.

In those inclement climates, in which it may be supposed man did not take up his abode until driven to it by overcrowding in more genial lands, all is so relatively recent that we get a perfect conception of the development from the Stone into the Bronze and the Iron Ages, the latter being supposed hardly to antedate the conquest of Gaul. The custom of depositing the most valuable possessions and the spoils of war as gifts to the gods, in lonely bogs, where they became safely enveloped in the preserving folds of peat, has made Scandinavia and Denmark one vast storehouse of antiquities. Moreover, the warriors of the Iron period were buried in great state, with horses and chariots, attendants, weapons, supplies of utensils and food, and even of large wax candles ; and we thus ascertain that they were picturesquely clothed and armed, immensely rich in gold, and skilled in the arts. The damascened and inlaid objects of iron have been admirably illustrated and described by Worsaae and Hildebrand, in the handbooks on Danish and Scandinavian Arts.* They suffice to show that the arts of ironworking, gilding, damascening, inlaying with gold, silver, copper, and tin, chasing, forging chain-mail, some of which were practised by the Gauls until lost in the fall of the Roman empire, were preserved and developed by the Goths of the north, who, though hemmed in and isolated by the sea, had for ages been pirates and sea-rovers. While the rest of Europe was desolated by battle and conflagration, this fierce people, restless and tired of inactivity, became intoxicated with the spirit of

* *Danish Arts*, Figs. 231, 232 ; *Scandinavian Arts*, Figs. 104, 111. Issued by the Victoria and Albert Museum.

adventure, and fanned by the sagas of their bards, poured their whole manhood out as the dreaded Vikings, to devastate and ravage again the coasts of Europe and Britain, but, at the same time, to reintroduce forgotten arts which were destined to influence the course of ironworking throughout Europe.

III.

THE AGE OF THE BLACKSMITH—DOWN TO
THE FOURTEENTH CENTURY.

THE jewellery and weapons of the Angles, Saxons, or Jutes, who conquered Britain, show that they practised the arts of working metals to the fullest extent then common to the barbarian peoples of Western Europe. They were pagans who beheld perhaps for the first time such buildings, streets, and cities as they were busy in ruining ; but scarcely were their conquests becoming consolidated than St. Augustine, followed by other missionaries from Rome, appeared upon the scene and began to re-establish a Christian Church. The sacred buildings would no doubt be erected on Roman lines, just as our own missionaries everywhere build on English models ; even if none of the old Romano-British churches and buildings could be utilised. The Romans themselves appreciated ironwork but little, and only used it when they needed its strength ; this, however, was not the case further north, as in Gaul, where its artistic working was highly developed ; nor in Britain. Though barbarian art faded in these countries on contact with that of Rome, in ironworking the conquered excelled their rulers, and Gauls and Britons may well have produced works under the Romans from which the earliest mediæval designs were taken. Unfortunately, though we are conversant with the weapons and utensils buried with their owners, in which classic models were not altogether followed, the ironwork associated with religion and architecture has perished. A few examples, believed to be of the Roman period, are preserved in provincial museums, and have been collected by M. Liger, from whose work our

illustrations are borrowed. Except in a few instances, these show little Roman influence, while they bear an unmistakable resemblance to later work, either because genetically connected, or simply that the craft of smithing produces similar results

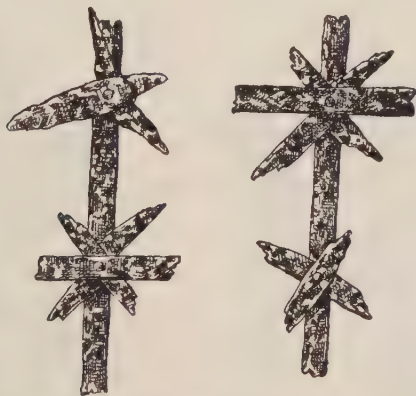
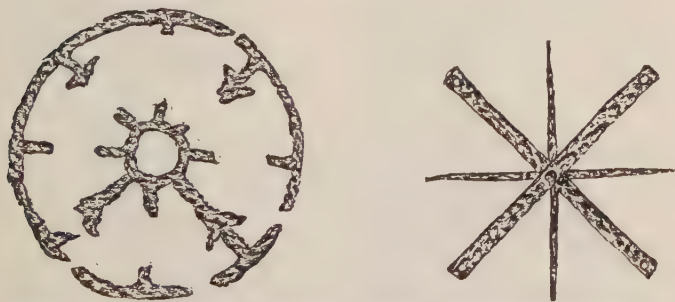


FIG. 1.—Parts of Roman window-frames found at Epinay.



FIGS. 2, 3.—Examples of wrought-iron window-guards of the Gallo-Roman period. In the Museum of Saint-Germain.

when like conditions are given. This is conspicuously the case with the grilles illustrated above (Figs. 1, 2, and 3), which show hardly any trace of classic refinement.

The resemblance to later work in the remains of hinges, fasteners, clamps, etc., is again too close to be merely

fortuitous (Figs. 4, 5, and 6). This is even more the case in the bronze clamps from Saint-Germain (Fig. 7), which are evidently from an iron original. All these are probably very similar to the contemporary British work, and are of the

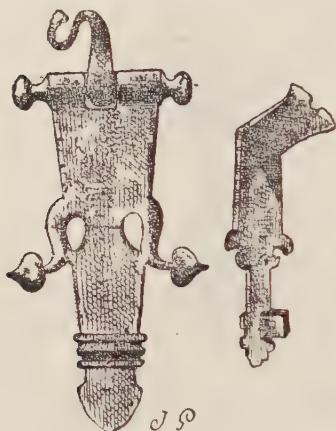


FIG. 4.—Iron hasp from Lundunum, near Vertault (Côte-d'Or).



FIG. 6.—Iron clamps. From the Museum of Saint-Germain.



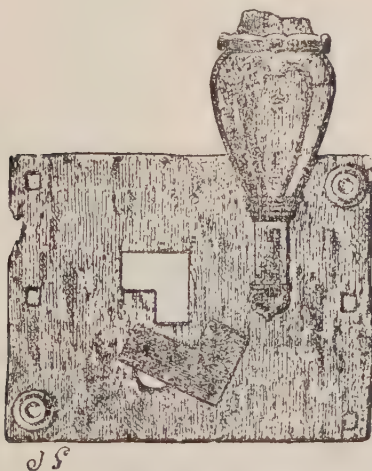
FIG. 5.—Gallic escutcheon of iron. After M. Liger.

greatest importance in tracing the development of mediæval metalwork. The destruction of Romano-British ironwork, perhaps owing to our climate, has unfortunately been such that we are unable to find more than a few examples boasting artistic merit in our own country. Excavations, such as those at Cirencester and Silchester, have been fruitful. The lock-

plate (Fig. 8) and fire-dogs from Hartlip (Fig. 9) and Colchester (Fig. 10) are valuable, even though their date, like that of the



FIG. 7.—Gallo-Roman clamps of bronze. From the Museum of Saint-Germain.



J S

FIG. 8.—Hasp and escutcheon from the Roman Villa at Hartlip, Kent.

iron candlestick from the river Witham (Fig. 11), is not definitely ascertained. The cup-like object in the British

Museum (Fig. 12) may possibly be a lamp. The iron folding-chair, with bronze ornaments, found with Roman remains at



FIG. 9.—Roman andirons found at Hartlip, Kent.

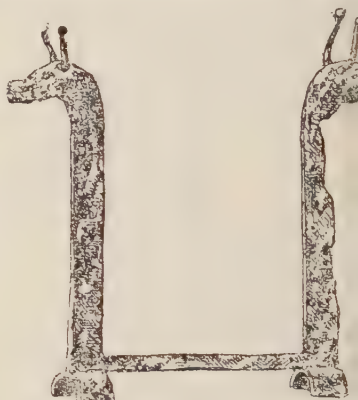


FIG. 10.—Roman andirons found at Colchester.



FIG. 11.—Iron candelabrum with pricket and sockets, found in the river Witham, near Kirkstead Abbey Lincolnshire.



FIG. 12.—Roman cup, from Broon field, Essex.

Ashdon, Essex (Fig. 13), is, however, a more unquestionable relic of Roman Britain.

Celtic art had found a refuge in Ireland, where it had long been maturing into the characteristic Irish art, with its refined and easy yet intricate arabesques derived from animal rather

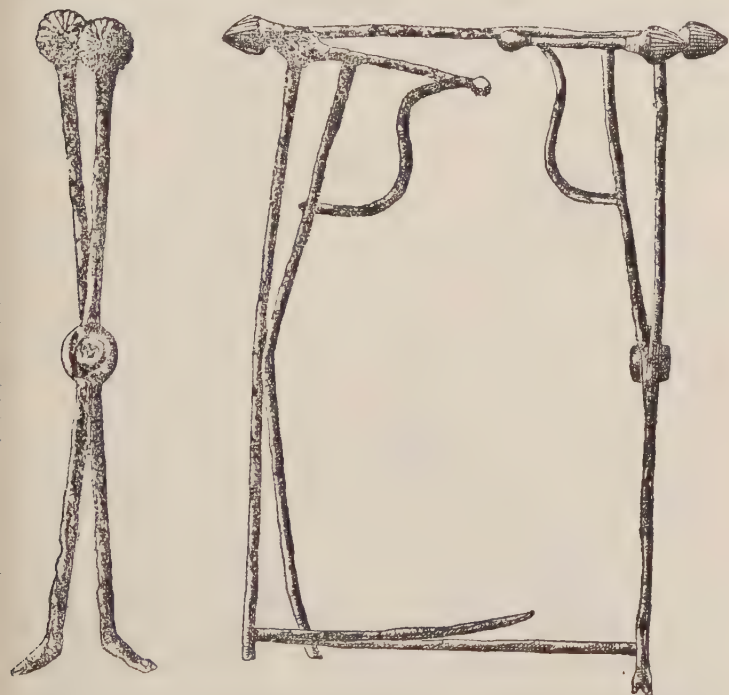


FIG. 13.—Iron folding-chair with bronze enrichments, found at Ashdon, Essex.

than from vegetable forms. Almost coincident with a probable revival of art under Roman bishops, this art, already established by St. Columba in Scotland, was being introduced into England from the North. Such busy prelates as the Northumbrian Aidan of Lindisfarne, 635, and St. Chad, Diocesan of Mercia, 656, Finan of Essex, and the Irish monk Fursey, who

greatly contributed to the conversion of East Anglia, powerfully aided the dispersion of this Irish ornament. Book, bell, and crozier were their weapons, and iron was in little request, but the objects of gold and bronze show that the highest pitch of metallurgical skill had been attained. St. Patrick's bell, riveted and brazed together, presents an object of iron with an unbroken record of fourteen hundred years. When, later, the Roman and Irish priesthoods were in process of fusion, some of the less trammelled richness of Irish art must have been grafted on to the more formal Italian, and largely contributed to give English work its special character.

In endeavouring to form an idea of the complex origin of English art, we cannot leave out of account the fact that the whole Christian Church was united in the closest bonds in its early days of struggle. Thus, Greek art no doubt reached us in the form of sacred objects from Byzantium, and, moreover, Greeks shared in the work of conversion, like Theodore of Tarsus, Primate of England from 669 to 690, whose labours, undertaken with a learned companion, gave England its intellectual eminence, and actively encouraged literature and the formation of libraries.

A close connection with Frankish art must also have been maintained, Agilbert, afterwards Bishop of Paris, holding the see of Dorchester, in Oxfordshire ; while later the English Alcuin was the favoured counsellor of Charlemagne ; and Erigena, an Irish Scot, was at once the most intimate and familiar friend of Alfred the Great and of Charles the Bald. England, indeed, at this time, even gave bishops to remote parts of Christendom, as Willibrod, Bishop of Utrecht, 693, and Boniface, the Apostle of Germany and Archbishop of Friesland, 732.*

Late in the ninth century a still more important influence

* Wynfrith, surnamed Boniface (doer of good) by the Pope, martyred 754 by the Frisians.

arrived to help to build up English art. The Danish Goths, who seem to have treasured and developed the arts that had passed from Gaul, began to settle on, instead of merely ravaging, the English coasts, and to fuse with the Anglo-Saxons, even, in the cases of Archbishops Odo and Wulfstan, giving primates to England. This people, who built ironclad warships, must, according to the sagas, have been the most



FIG. 14.—Bosses of Shields in the British Museum.

expert blacksmiths the world has ever seen, their royal princes not disdaining to work as armourers and smiths. Their weapons were of great beauty, and their swords, to which they gave names of affection that have been handed down with their own, almost objects of worship. It is unlikely that the Anglo-Saxon, who so quickly appropriated the terrible Danish axe, would have neglected to avail himself of the presence of such smiths as these, and, with the advent of the Dane, the elements of which English ironwork was an outcome,

are complete. Of the early stages of its development we know little, and perhaps never can hope to know much, but we do know that English metalwork generally stood in high repute. The varied bosses of shields in the British Museum (Fig. 14) of Anglo-Saxon date present examples of most difficult forgings. As the accident that Greece was the meeting-place of the arts of Assyria, Egypt, and Asia Minor, in Homeric days,



FIG. 15.

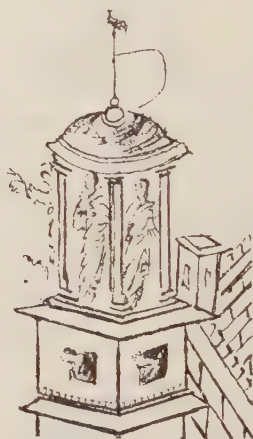


FIG. 16.

Weathercocks, from ancient MSS.

led to the magnificent Greek development of art, so the convergence of such dissimilar styles into a single focus in the hands of the new and vigorous English race appears to have led to a departure which bore important fruit. Anglo-Saxon manuscripts like the *Cædmon*, in the Bodleian Library, Oxford, abound in representations of ornament of the most exquisite character, in which foliage of thirteenth-century type, derived from Greece, commonly appears, and from which it would seem that many architectural details, like the

capitals and mouldings of pillars, were possibly of metal. Mr. Parker was of opinion that metalwork at this time led the way in art, and was far in advance of contemporary architecture. Indeed, in the crisply curling leaves with dotted stems bound together with bands, the twined and knotted ribbons, scales, and checkered patterns of English ornament, we seem in presence of reminiscences of a metal decoration of the richest character. In the time of St. Dunstan gables were decorated with finials of simple fleur-de-lis-like outline, or foliage, and



FIG. 17.—Weathercocks from ancient MSS.

turrets and cupolas bore weather-cocks of forms which tradition has handed down intact (Figs. 15, 16, 17)...

No object in iron, moreover, is so frequently preserved as the hinge, so many examples having probably escaped destruction because they were closely affixed to wood, and were efficiently protected from rust by gilding or tinning, and by paint. Their removal was a tough job, presenting little temptation to the iconoclast, whilst, being useful as well as ornamental, they were rescued and applied to new doors when the old woodwork decayed. The simplest form of metal hinge would be a strap bent over at one end into a socket as in the Roman examples

which could work on a pivot fixed to the door-jamb, but even in the Roman period much more advanced forms were in use (Figs. 18, 19, 20). In Fig. 18 we have a strap of iron clasping the front of the door, then passing to the back and bent at the

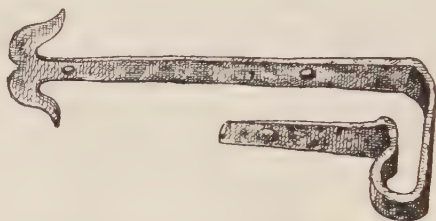


FIG. 18.—Hinge from Roman ruins, Jublains.
Now in the Museum at Laval.

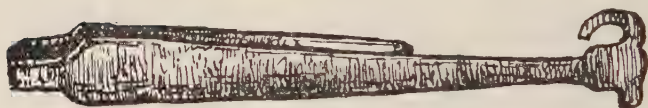


FIG. 19.—Iron hinges in the British Museum.



FIG. 20.—End of an iron
hinge in the British
Museum.

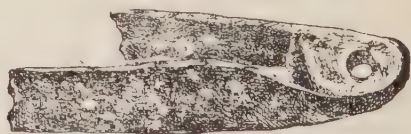


FIG. 21.—Hinge from Lundunum, near
Vertault (Côte-d'Or).

angle to form a socket. This very primitive arrangement, like the curious type in Fig 21, in which the pivot is central and let in the slightly hollowed door-jamb, did not survive, but the strongly welded hinges with straps clasping the door both back and front, and the socket fashioned out of a lump

of solid iron on one side, known as the Flamand (Figs. 22, 23), is even now the best form of hinge in use. Nothing, however, is more frequently represented than door-hinges, wherever any approach to architectural detail is rendered. These are usually straps, with one, two, or three pairs of simple scrolls, Figs. 24, 25; but in the Cædmon MS. the types, many of which are figured in Parker's *Glossary*, are more diverse and include leafage. Sometimes a door is represented with ornamental strengthening pieces, and occasionally in English manuscripts the entire door is covered with ironwork of great richness, Fig. 25. The sketch from the Rouen Library is roughly executed in ink on the second title-page of the Anglo-Saxon Pontificale which belonged to Robert, Archbishop of Canterbury, about 1050. The elaboration of these simple hinge-straps into scrollwork may have originated in the effort to spread them over as much of the door as possible, like a bird's talons; for Northern pirates were recommencing their descents on the English coasts, and the church door might at any moment be thundered at by hordes intent on pillage and slaughter. One of the most resisting, and therefore prevalent forms, appears to have been a triple strap, the centre straight, and the lateral curved like the horns of a crescent. Its triple form was perhaps regarded as symbolic, but the springing of all three straps being behind the stonework when the door was closed, made it particularly difficult to wrench off. The ends of these straps are often beaten into scrolls and foliage whose fashion is an indication of age, which the form alone fails to convey. Sometimes one or two additional crescents spring from the central strap, or are butted on to it; in fact, for two or three centuries the ingenuity of the smith was exercised in inventing variations, in which relative rudeness and plainness afford no guide to age. An early carving from Selsey, now in Chichester Cathedral, represents the crescent hinge with split and scrolled ends, but without the centre strap; it



FIGS. 22, 23.—Hinges found near the source of the Seine.

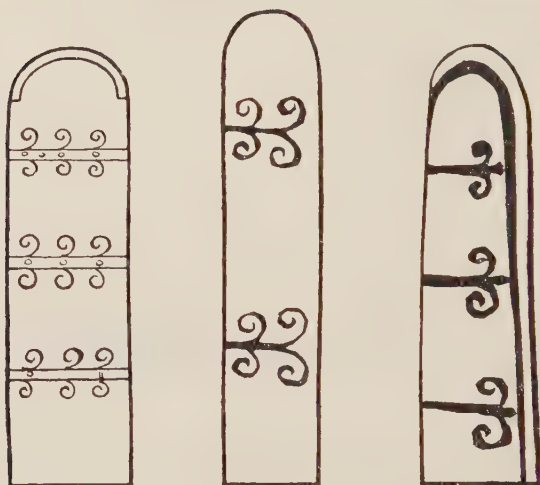


FIG. 24.



FIG. 25.

Strap-work, from ancient MSS.

dates back probably to the twelfth century. It does not appear to be derived from the horseshoe, a form sometimes used in homage to St. Martin, the patron of wayfarers.

Two or three of these hinges were used to each door, and further strength was generally gained by the use of bars and straps between them. When space permitted, the central strap took an elaborate form, often a richly scrolled cross. But it is obvious that, however the planks of a door might be clutched by external hinges, the woodwork could be burst in, unless bound together from the inside. Doors must have been so strengthened from an early date, and in the hands of accomplished smiths this defensive plating, no doubt, assumed an elaborately ornamental character. When the wood required renewing in later times, this decorative system of interior armour-plating has sometimes been transferred to the outside as ornament.

The frequent occurrence of mystic figures, of ruder character than the ornament with which they are associated, appears to come from the Danes. An early and grim association in the popular mind of the Danes with hingework began when their skins were nailed to the church doors—a custom perpetuated by stretching dressed skins of scarlet hue over the wood and under the tinned or gilt ironwork, to enhance its decorative effect. The Danes scarcely abandoned their superstitions, when converted to Christianity, so readily as the Anglo-Saxons; and church doors are sometimes found not only decorated with hingework, but profusely covered with pagan emblems and signs, perhaps intended, as when the Romans fixed nails on their doors, to dispel evil. The two most interesting specimens extant are at Stillingfleet in Yorkshire (Plate 1), and Staplehurst in Kent. The former had two crescent hinges ending in serpents' heads and an interlacing rope-like strap, together with a Viking's ship, two human figures, a swastika, and other signs, some of which, with the sails of the ship, have now

disappeared. The doorway is a rich specimen of Norman work of about 1145. The Staplehurst example is similar, but the arrangement is more confused, perhaps because the work has been removed from a round and refixed on a pointed doorway. The hinge is of the crescent type, with diapered surface, but with a disconnected centre strap and reversed crescent at the end, terminating in the usual types of serpents' heads; and the ornaments still comprise a Viking's ship, fishes, a goose, sea-dragon, snakes, crosses, and other objects of deep import, the whole recalling the ornament on the golden horns figured by Worsaae in his handbook on Danish Art.* Though the existing door is now but partially covered, the original door probably resembled those peculiar to Denmark and Sweden of later date.

A door at Skipwith, not far from Stillingfleet, furnishes a rare example of a defensive lining of geometric design formed of intersecting circles, with crosses and knotted swastika-like ornaments in the interspaces. A still more remarkable geometric treatment is preserved in a Romanesque doorway at Much Hornead Church, Hertfordshire, and consists of a rich border of small scrolls enclosing two nearly square panels, filled with geometric ornament made up of segments of intersecting circles (Plate 2). The lower ornament had four dragons and some scrolls in the interspaces, which disappeared nearly a century ago, and above the upper one is the reminiscence of a Norse sea-dragon. The great north doors of Durham Cathedral seem to have been entirely covered with vertical bands of the same ornament produced by the intersecting parts of four circles, studded with nails, the marks of which still remain distinctly visible. One of the most ancient examples of the crescent form of hinge is at Willingale Spain, near Ongar, in a plain and very early arched doorway, in which

* Similarly rude figures are seen in early Norman work, as on the font in Stow Church, Buckinghamshire. *Builder*, vol. IV., p. 355.

Roman tiles have been used (Plate 3). The hinges are sturdy, the junction of the straps is far behind the door-jamb, as in all old examples in England, and the crescents end in peculiar dog-like heads flat and in profile. Between them is a narrow strap, bordered with a frill of scrolls welded to it, and swelling out between the scrolls where the nails are driven. Above and below both hinges were straps of the same kind, arranged in threes, with the points converging, forming, when perfect, four great figures like the Government broad arrow. The door is bound round the edges, and the handle encircled, with the same frill-like ornament, and wherever possible the surface of the iron is enriched with a cross-hatch diaper. A much richer example of the same type, and only a very little later, is preserved on the double doors of the north entrance to St. Margaret's, Leicester. Its salient feature is, as at Willingale, the javelin-like straps, set horizontally and obliquely between the hinges. Where not ending in spear-points, the straps finish in serpents' heads either beaten in flat profile or modelled on plan, and the whole has been diapered as at Willingale. This work had been removed from an older door and applied to the present one in the fourteenth century, when some later work was added. The fact of so much of the archaic ironwork having been preserved and utilised in the fourteenth century shows, as we shall presently see, that the art of working it into intricate forms had vanished. An aberrant example exists at Edstaston, Shropshire, where crescents face each other at both ends of the hinge-straps, with subordinate ornament recalling other heavenly bodies. Another fine example, in which the binding and strengthening straps are perfect, is preserved at Hartley, Kent. Here the central hinge-straps pass across three crescents, some of which end in dragons' heads in relief and on plan, and the rest in various scrolls and fleurs-de-lis. Some of the diversity may be due to repairs, and the iron has been rearranged. Other well-known examples

of early date are at Erith, Maxstoke, Westcott Barton, Margaret Roding, Compton, Norton, etc., and later ones in Gloucester and Hereford cathedrals, comprising strengthening pieces with singularly bold trident-shaped ends, which seem peculiar to the West; and in Peterborough and Chichester cathedrals, which betray slight indications of the coming leaf-work. Two other interesting examples exist at the village church of Eastwood, near Rochford, Essex (Plate 4). In one we have crescent hinges without a central strap, ending in scrolls, and diapered in the manner of the earliest examples, faced by corresponding detached crescents with fish-shaped straps between them. These and other straps, as well as the binding to the door, are frilled with scrolls as at Willingale. The second door is similar, but the binding has no frilling. As in the case of Leicester and St. Albans, there are fourteenth-century additions to the latter, this time in the form of a scroll design with vine leaves cut out of sheet iron and nailed to the door. The crescent hinges with detached straps, on the door in the north aisle of Canterbury cathedral, are very similar in fashion to those at Eastwood, and were probably utilised from an older doorway.

Some singular modifications of the crescent hinge, which are certainly not later than the twelfth century, occur in Norman church doorways at Kingston Lisle, Berkshire, and its neighbour, Sparsholt. In the former the reinforcing strap is like a two-headed centipede, recalling the Eastwood ones; and in the latter the crescent ends are continued into scrolls of a quite abnormal type, branching into a form that we see in Germany at a much later period.

A more typical example is that in the Early Norman doorway of Haddiscoe Church, Norfolk (Plate 5), in which the crescent straps become almost bent into right angles, and branch profusely into scrolls on both sides. The door is almost completely covered with ironwork; a large Greek cross,

elaborately scrolled, and with the characteristic open interlaced centre, occupies the middle, and a similar and much smaller cross is above it. Kenilworth Church possesses a similar example, but spoilt by restoration ; and there are less perfect examples, of the same date, at Hales, Raveningham, and several other places in Norfolk and Suffolk.

Reference to ancient manuscripts shows that the crescent was far from the only type of hinge in use. Another consisted essentially of a stout central stem, branching into scrolls, often mingled with foliage. Some remarkable examples of these were on a door in St. Albans Abbey ; two are now in the Victoria and Albert Museum (Plate 6). They each consisted of six much convoluted scrolls, springing from a main stem, with zigzag lines over the surface. In one design a very eccentric and stiff serrated leaf, with incised venation, occurs on either side, and the scrolls end in rudimentary leaves ; and in the other they end in ordinary dragons' heads in high relief, except two, which are in profile with distended jaws. They were formerly on the slype door in the south transept of the Abbey, and date from the twelfth century.

With the Norman Conquest, the pressing need for defensive armour-plating to church doors passed away, and the mystic, almost hieroglyphic, treatment of the hingework did not long survive in England. In remoter Denmark and Sweden it found a congenial home, and there hingework is for the most part rude and uncouth, though greatly elaborated. Several examples have been figured in the *Oeldre Nord Architectur*, but it is difficult to place them in any chronological order, unless dated. Styles and fashions penetrated so slowly in the past that it is impossible, without great local knowledge, to predicate the date of any work from its style, where the style is borrowed and not indigenous. Thus, until within the last eighty years, the embroidery and wood-carving of Iceland

scarcely differed in style from the Bayeux Tapestry ; and the ironwork of Denmark, outside the capital, underwent little change until far into the seventeenth century. None of it was defensive, nor very early. That on the granite church of Gronboek, in Jutland, is slender, and appears to date from the fourteenth century. The round-headed doors of Skoneberga, in Sweden, are divided into transverse panels with a border, closely filled with diapered ornaments, crosses, scrolls, an arcade, and the knotted cord of Stillingfleet. Another Swedish door is divided by fleur-de-lis-headed straps into six panels, filled with the date 1489 in black letters, punctuated with men, fish, two-headed eagles, dragons, etc. Others, like Redsted Church, recall hinges from the south of France ; whilst others, again, have a more German aspect. Sometimes the treatment is very plain, and the hinges on one of the most richly carved wooden doorways in Norway are like our most simple fifteenth-century straps. Examples seem to be very numerous and varied, and would deserve careful study, reproducing, perhaps, the spirit of many a design that once existed here, of which there is now no trace. Our two examples (Plates 7, 8), are taken from Du Chaillu's *Viking Age*, and represent a door (in the Stockholm Museum) from Vänga Church, in Östergötland, and that of Faaberg Church, nine feet high, of a type that is extremely rare.

Byzantium and Rome having used little iron in architecture, we look almost in vain for decorative ironwork wherever their styles prevailed in Europe. Doors to the more imposing buildings in France and Germany were in bronze, in the Italian and Greek fashion, or in its substitute, carved wood. Owing, however, to the influence of such great Englishmen as Boniface, the apostle of Germany ; Alcuin, the preceptor of Charlemagne ; and Erigena, the counsellor of Charles the Bald, English fashions may have prevailed in places, and something like English hinges are occasionally represented on

doors in Frankish missals of their date. Whether judged from these or from existing specimens, ironworking, whilst it flourished in England, seems to have been in France of the simplest kind. It had no place in the great art revival emanating from Cluny, and no decorative ironwork appears in the accounts of the building and furnishing of the Abbey of St. Denis by Suger, 1137-1140. That the earliest designs were derived from England seems clear, since they are all based on the crescent form. We find the true English form at St. André, Chartres, and St. Lo in Normandy. But in appropriating our form, they usually failed to recognise that its value lay in keeping the springing of the crescent and central straps at the very base of the hinge, where the junction would be protected by the door-jamb. Probably on account of the great difficulty in forging it so, we either find the lateral straps forming the crescent stalked far forward from the butt, and the central strap omitted; or the latter was detached, and became a mere ornament. France at this time consisted of seven or eight independent provinces, differing radically in race and language, and each possessing its own style of architecture, founded more or less on existing Gallo-Roman buildings, or perhaps suggested from the East. The distinctions in style are particularly apparent in the doorways to the churches, and it is impossible, according to Viollet le Duc, to confound a Romanesque doorway from Champagne, for example, with one from Auvergne or Poitou. Little of the ironwork of these provinces is published; but, as far as we can see, it is similar, as if it had spread from a single centre of origin. The hinges and the strengthening pieces, instead of being each in a single piece as with us, are subdivided into numerous small pieces fixed separately to the doors, and forming a more or less geometric arrangement of detached ornaments, in which the crescent predominates. Moreover, these pieces, instead of being solid, as with us, are

very generally forged or pierced into openwork patterns like lace, producing a fantastic effect very foreign to the quality of strength. That the art remained exotic is shown in the fact that, except the cross, the forms had no reference either to

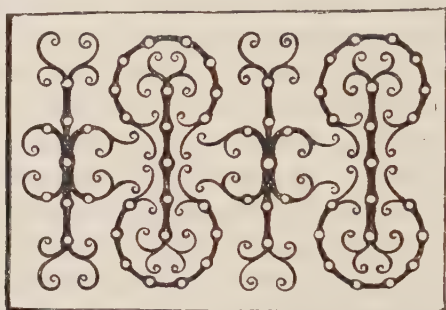


FIG. 26.—From the Abbey Church of Pontigny.

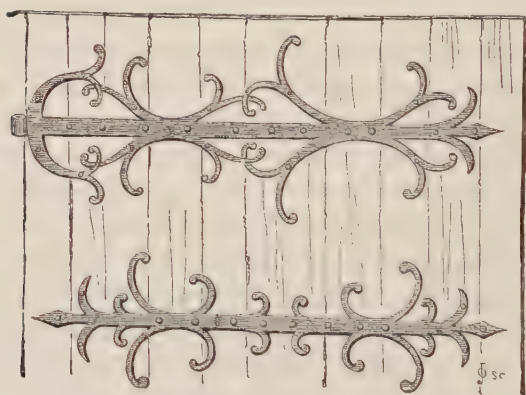


FIG. 27.—Hingework at Montréal, Yonne.

strength or symbolic derivation, and neither animal nor even vegetable forms are ever introduced. No meaning attaches to the complex designs, and we can only regard them as sports from an original stock, which developed no further. On the cathedral doors of Angers the pieces are placed in random patterns over the doors. In Champagne we again meet with

the same small detached crescents and straps, with much piercing, arranged in patterns, with many smaller scrolls. The finest example is at Pontigny (Fig. 26), but the style penetrated to the borders at least, of Burgundy, at Montréal (Fig. 27), and Chablis ; and to distant Cologne, in the Church of St. Ursula. Examples, however, are most numerous in Aquitaine, a fairly consolidated kingdom in the eleventh century ; and especially in the district of Auvergne, where the churches have not been rebuilt. There are examples at Le Puy-en-Velay, St. Julien de Brioude, Orcival, Auzon, Champagnac, Frugères-le-Pin, St. George-les-Alliers, and many villages ; all associated with Romanesque doors, and probably as old as the twelfth century. On the borders of France, in Alsace, we meet with a single special development. The hingework of the Abbey of St. Jean-des-Choux, splendidly illustrated by César Daly, in the *Revue Générale de l'Architecture*, is of the richest description. It consists of three bands on each door, each composed of a crescent and a circle of broad iron with upturned edges, between which an intricate filigree pattern is enclosed, like contemporary goldsmiths' work.* The horns of the crescents end in a usual Frankish tongue between two scrolls, a vestige of the Greek honeysuckle or palmette, while other scrolls with similar ends are included, not only within the circles, but in the spaces between them and the crescents. The peculiar twelfth-century hinge figured by Viollet le Duc from Schlestadt, also in Alsace, is clearly derived from this example, and we find the crescent and circle reappear near Brunswick a century later.

The rise of laic, as opposed to monastic architecture, which commenced, according to Viollet le Duc, in the Royal Domain, led, perhaps, to a more simple and restrained treatment of the

* Jan Van Eyck represented the closed door of Ezekiel with a band and three hinges of this work in gold, set with sapphires and other jewels : it occurs on a triptych, " Our Lady and Child, and the Donor."

hinge. Examples of such are rare, as most churches of importance were rebuilt or greatly altered during the birth of Gothic architecture. There are some refined crescent hinges, with detached straps and foliated ends, at St. André, Chartres ; interesting from their likeness to those on the door of the north aisle of the choir at Canterbury cathedral, which may have been inspired by a French architect. From indirect sources, such as representations on carving, stained glass, etc., we gather that in France proper—and, perhaps we may add, in the provinces in which Byzantine and Oriental architecture was the model—ironwork was very simple, the strap with diverging scrolls and the crescent being used indifferently. But towards the end of the twelfth century a new and beautiful style of work was introduced in Berri and parts of Auvergne, examples of which are figured by Le Duc and others, from Neuvy-Saint-Sépulcre, Levroux, Le Puy-en-Velay, Orcival, and Ebreuil. In these we find the hinge-straps and scrolls no longer scored with a graver or chisel, when ornamented, but moulded under the hammer ; and this particular type is characterised by the constant repetition of the Greek honeysuckle or palmette, a tongue between two unequal scrolls, for every termination, and a tendency to geometric arrangement. The pair of oak doors from Gannat, Auvergne, in the Victoria and Albert Museum (Plate 9), dating from about 1200, furnish a good example of this type, but the straps are scored with a chisel as in earlier work. Geometric ornament is commonly met with in France on carving, stained glass, embroidery, etc. We have a splendid example of this work on the north aisle door of Durham cathedral (Plate 10), leading to the cloisters. It so closely resembles the French hinges in every detail, and is so unlike anything else in England, that we must regard it as a French production, especially as it is in detached pieces, not welded together, but merely nailed separately to the door—a peculiarity never seen in English work, but common in

France, and one which would in this case have facilitated its transport. The doorway is regarded as dating from about 1135. The hinges are of the crescent type, with a large double scroll springing on either side from near the end of the strap. Between the hinges is a beautiful and uncommon diaper of large intersecting lozenges, interlacing with a cruciform design of scroll-work, similar to the scrolls of the hinges, but on a reduced scale, and producing a rich effect. There is a consensus of opinion in France that the French were capable of producing this modelled work from quite early in the twelfth century ; and its foliated work, beaten in relief with deeply grooved stems, was undoubtedly the precursor of the magnificent stamped ironwork so intimately associated with the vast cathedrals, planned and erected between 1180 and 1240, in the Royal Domain of France. With the exception of some hinges at Ripon, this remarkable specimen appears to have had no influence on English work, and down to the introduction of pointed architecture, English ironwork was scarcely influenced by the Norman-French. The salient features of the English work were strength, independence of architectural style, and designs dictated by necessity or derived from symbols, embellished with ornament taken almost exclusively from the animal world. It is a significant fact that although Norman craftsmen supplanted ours in every other industry, so that the English names for mason, painter, carpenter, joiner, plumber, tailor, etc., disappeared, this was not the case with either the smith, his tools, or the metals he used. The merely mechanical branch of the craft, the farrier's, was alone permanently associated with his Norman rival.

Treasures in the old days, when they comprised deeds, plate, bullion, and jewels, seem to have been as effectively safeguarded as in these days of bankers' strong-rooms and burglar-proof safes. The smith and locksmith, mason, and warder were the constructors then as now ; the strongest rooms of a

building, with approaches most constantly under supervision, were constituted the treasuries. Crypts or vaults under the chapter houses of cathedrals and the private chapels in palaces were usually selected, and the trained vigilance of the monks relied on to protect them. Rarely was the trust reposed in them betrayed. The notable exception historically was the great robbery of the royal treasures of Edward I. in 1303 from the Chapel of the Pyx, situated under the chapter house of Westminster. Monks were accused with others, and some may have suffered the recognised punishment due to so heinous a crime at that time of being flayed alive, for the doors have been found to be lined on both sides with human skins. These vaulted chambers down among the foundations of ponderous buildings must have been invulnerable except through doors or windows. The valuables were of course secured in coffers. These were of stout oak almost hidden under the iron bands and hinge-work and the numerous locks and padlocks, and too heavy for removal; an example in the treasury of Chichester is eight feet long with five locks. Thus we learn that Henry I., on receiving his portion of £5,000 in silver from his father, deposited the treasure in a coffer strongly bound with iron and supplied with good locks. Very many of twelfth- and thirteenth-century date still exist; but large coffers wholly of iron do not appear till the sixteenth century. All accessible window-openings were barred then as our prison windows are to-day, by strong iron bars intersecting rectangularly by means of eyes welded in, but in the case of treasuries the grilles to the windows are doubled one behind the other as at Canterbury (Plate II) and Wells. The doors, however, presented the chief difficulty, and with them the most elaborate precautions were taken. They are naturally of the stoutest planks securely framed and backed, studded with nails and iron strap-work. Immediately after the scare of 1303 a new door was ordered for the treasury at the Tower,

for which John Le Flemyng received 77s. 4½d. It is worth noting how persistently Flemings were employed on this class of work. The door to the Chapel of the Pyx still exists, but the most perfect examples are those at Wells. One of these, in addition to the timber work, is lined with plate iron, further strengthened by welded bars intersecting diagonally, swelled at intervals to permit the passage of nails and scrolled at the ends. The locks are of unusual size and the bolts very strong. If contemporary with the crypt, the doors would be of the late thirteenth century.

It is difficult to say whether grilles of scrolled iron were first used in English or in French abbeys and cathedrals, for there are no illustrations implying their use previous to the twelfth century. Though the term "chancel" implies the presence of a grille, the simple plan of early churches would have precluded any extensive use of them. We find, however, that metal grilles of simple design were used even by the Romans in doorways, and as railings in temples, amphitheatres, and public buildings. The earliest instance of a Christian grille is of pierced bronze, repeating the Greek cross within a circle, separating the Church of the Nativity at Bethlehem from the underground crypt or cave, and may date back to the fourth or sixth century. A bronze grille of open scale pattern with the Latin cross exists in the crypt of Sant' Apollinare in Classe at Ravenna, and is of the sixth or seventh century; while the fine bronze grilles to the triforium at Aix-la-Chapelle date from the ninth century. Some of the doorways and windows of St. Mark's, Venice, are closed by bronze grilles; and there are many references to grilles of bronze in early writers, and even to the existence of silver grilles at Rome and Constantinople; but the divisions in the interior of basilicas were ordinarily low and of stone or marble. The fully developed Norman cathedral, with its shrines and reliquaries of precious metals, first necessitated an extensive use of grilles to enclose the choir, and, later on, the added side chapels. The requisite

strength and translucency could best be obtained by the use of iron.

No earlier type is known than that at Winchester, which dates probably from 1093. The north of France and Normandy possess none which can claim so great an antiquity, and only at Le Puy do we find one ascribed by Le Duc to the twelfth century. From its richer style, dotted as it is all over with punch-marks, and its greater lightness, it should be the later of the two. Those in Spain of the same style are situated within a triangle to the north of Madrid, and cannot, from the date of the buildings, belong to so early a period; they were perhaps introduced with French architecture.

The Winchester example (Plate 12), though now reduced to a mere patchwork of fragments against a door in the nave, formerly protected St. Swithin's shrine, and was originally placed at the head of the stone steps which lead up from the south transept to the ambulatory; the places of its fastening into stone piers on either side are still quite easily traced. It was intended to exclude pilgrims from the choir, south transept, and nave. They entered and left by the Norman doorway in the north transept; they could get round far enough to see the high altar and then had to go back. It is constructed of groups of C-shaped scrolls, which are elongated so as to admit of a grouping by threes, one within the other; two bundles of three scrolls are strapped together back to back by iron ties, and the interstices are filled with smaller scrolls. The ends of the C-scrolls are forged into an open cinquefoil cluster in part of the grille, and a trefoil in the remainder. In the latter the heavy effect produced by the six or more thicknesses of iron bound together is overcome by thinning them down and welding, by which greater transparency is obtained without any sacrifice of strength.* In Spain there is a grille in the

* A reproduction in wrought iron of part of this grille is in the Victoria and Albert Museum, No. 1891-27.

north aisle of the Romanesque church of San Vicente, at Avila, near Madrid, which has the same cinquefoil clustered termination. A door to the Capilla de Santa Cruz, in the cloister of Pamplona cathedral, is a better-known example of the same type, and has been described by Street. It dates from 1212, and is said to have been made from Moorish chains. Another exists in the so-called Reja Arabe de la Capilla del Sagrario in the cathedral of Palencia; and windows in the façade of Nuestra Señora del Mercado at Leon, are grilled with similar ironwork. A peculiarity which distinguishes this type of grille, and gives them a singular resemblance to each other, is the number of whorls into which the scrolls are worked, and the persistent way in which, whether large or small, their final terminations form small but complete rings. There can be no doubt about these and the Winchester grille having a common source; notwithstanding that only one of the kind exists *in situ* in France, at Le Puy-en-Velay, in Languedoc. This is the grille just alluded to, on the west side of the cloister, and has been figured by Viollet le Duc and by Gailhabaud. The finest, and probably latest specimen of the type, however, has been broken up; and pieces, especially one of them converted into a fire screen, have been figured by many authors. It forms a rich arabesque, like old Venetian point lace, with the scrolls gathered into thick masses under the collars. Panels of this screen (Plate 13) assigned to the thirteenth century are in the Musée Le Secq des Tournelles at Rouen. They came, it is said, from the great Abbey of Ourcamp, in Picardy, ruined in the Revolution; in which case they may be of the date of its reconstruction, 1201.

A more simple and probably rather later type is seen in the choir grilles at Lincoln (Plate 14), which are still the most perfect of their kind existing in England. They are composed of a massive framing divided into panels of the whole height of the screen, filled in with a multitude of small C-scrolls tied together

in pairs. A small pierced sheet-iron border of quatrefoils forms a base, and, as in all screens of this type, the cresting must have been a simple arrangement of spikes for defence. Canon Venables noticed the identity between them and some of the screens closing the circular choir of the Dome of the Rock at Jerusalem, which must have been erected by the crusading monarchs between its capture in 1099 and its recapture by Saladin in 1187. The Lincoln example may be of similar age, since the twelfth-century choir and eastern transept, 1186-1200, must have required protection from the beginning. The type seems to have been very popular, as a picture in the Louvre, by Jean Jouvenet, shows that all the chapels behind the *maître autel* at Notre Dame, Paris, were closed with grilles of this kind; and another is shown in an old view of Arras Cathedral, securing the altar and reliquaries. The destruction of mediæval church grilles in England has been almost complete, not a vestige of any remaining in the cathedrals of York, Durham, Chester, Peterborough, Ripon, Lichfield, Norwich, Worcester, Hereford, Gloucester, Exeter, Manchester, Bristol, Carlisle, nor in any of the great abbeys or churches. A fragment shows that St. Albans once possessed such grille-work, and the grilles to St. Anselm's Chapel in Canterbury cathedral are survivals of the type. In France the change of fashion under Louis XV. was even more destructive, and the only choir grilles of the kind remaining are at St. Germer, near Beauvais; though there are fragments preserved from St. Denis, Cluny, and elsewhere. Windows at Noyon, Beauvais, and the fortified church of Béziers, are still protected by the same description of grille; and numerous specimens are to be found in the public and private museums of France. In the Cathedral of Conques there is an ancient choir screen somewhat linking this type with that at Winchester, and remarkable for its formidable spikes.

A third type of early grille (Plate 15), remarkable for an

absence of symmetrical arrangement, was formerly in Chichester cathedral. In this case the smith, perhaps Henry of Lewes, had apparently licence to diversify the work as he pleased. The grille was composed of panels of small and very delicate scrolls between vertical bars, divided horizontally in two, the filling of the upper half not necessarily corresponding with the lower. The design seems to have changed with every few feet, the fashion of the scrolls, especially those of the upper part, affording a variety unknown elsewhere. A length of it was discovered in a builder's or dealer's yard in Chichester, having presumably been removed when the tower was rebuilt. A sketch of it as it stood in 1872 may be seen in the Transactions of the Royal Institute of British Architects for 1891, but no representation of it when in the cathedral before the accident has been published. This piece was recovered and replaced in the cathedral, but its dilapidated condition led to its final removal and the transfer of four of the panels and part of a gate to the Victoria and Albert Museum. Though much decayed and damaged, with the scrolls confused and displaced, they still present a unique and priceless example of the grille-work used in an English cathedral in the thirteenth century.

Some of the scrolls of the fourth panel in Plate 15 terminate in rude stamped rosettes—an obvious foreshadowing of the highly enriched grilles of the next century. A fine grille of the same irregular kind and of early twelfth-century date is figured by Gailhabaud* from St. Aventin. A later variety, in which the frames are filled with scrolls welded in pairs to short detached bars with slightly beaten ends, is to be seen in the museum at Auxerre, and in the Porte du Cimetière at Cravan, Yonne.

As we reach the thirteenth century, we see the older diverse elements fusing into one definite style, and, as Romanesque

* J. Gailhabaud—*L'architecture du V^me au XVII^me siècle*, Vol. IV., p. 274 (1858).

and Norman pass to Transition, the unlimited freedom of the smith is curtailed. The birth of Gothic architecture, with its scientific construction and refined ornament, is reflected after a time in the increasing grace and elegance of the ironwork. The need for defence had passed away ; Celtic, Classic, and other styles have merged ; and the traces of the Dane are barely discernible with us in the occasional dragon or grotesque monster. A rich system of easy-flowing, yet elaborately foliated scroll-work was the first result. One of the most beautiful examples (Plate 16), and probably the earliest, is preserved in the entrance to Worksop Priory. It lines and completely covers the doors with its graceful scroll-work, but is unconnected with the hinges. The leading scrolls take bold sweeps, forming six nearly complete circles, which are filled with the lilies and scrolls proceeding from their branching ends. Each leading scroll bears four twelfth-century iris flowers of varied forms, increasing in complexity towards the apex ; those at the summit being as rich as any seen in painted decoration.* This specimen, now unfortunately restored, which was the finest of its kind, influenced a great deal of work, and there are hinges taken from it as far distant as Burford in Oxfordshire and Abbey Dore in Herefordshire. Another interesting and unique example of early thirteenth-century design occurs at Wells, in which scrolls spring from the hinge-straps and branch into small lozenge-shaped leaflets, while slender wingless birds, attached in pairs with flowers between them, fringe the straps. It is, of course, impossible to record in a limited space all the exuberant forms that mark the Transition. For a time they were dictated by caprice, though the ideas were probably suggested to the smith, but they soon settled, where foliage was used, into reproductions of the vine the emblem of the Church ; its fruit, foliage, and tendrils

* A cast of part of this door is in the Victoria and Albert Museum no. M. 1916-19.

its trailing, climbing, and drooping habit, pre-eminently fitting it for this purpose. The vine, already highly conventionalised in Greek and Roman art, had been incorporated into Byzantine and Romanesque ornament. The form chiefly adopted by the smiths had already appeared in Anglo-Saxon manuscripts, and in bronze on the ninth-century doors at San Zeno, Verona, modelled in high relief. The type was equally taken hold of by the contemporary wood-carvers, and is thoroughly familiar in thirteenth-century carving. Its use in smithing seems to have originated in England, for we find it in the richly-worked Early Norman doorway of Sempringham Church (Plate 17). Here the hinges are of the crescent form, greatly enriched with leafwork, and the door is bordered with ornaments like the hinges in miniature; while nine cruciform pieces of similar detail lend additional strength, and under the arch the rude figures of a cock on one side, and a man on the other, are still traceable. The whole effect is clumsy, but distinctly foreshadows later work. A curious set of hinges is to be seen on an early thirteenth-century doorway in Market Deeping Church (Plate 18). They are slender and of crescent shape, branching copiously into leaves beaten almost flat along one edge, and with something of the simple outline of the peascod. They are associated with rude attempts at bunches of grapes, and a couple of rude human or fiends' heads lurk among the foliage. A slightly later example, perhaps derived from it, occurs in the north aisle door at Lincoln. It consists of two strap-hinges, whose scrolls fairly cover the entire door, and form a centre with only one additional strengthening piece; the scrolls branch twice, and all terminate in a central and two recurved lateral slender leaves. There is quite as beautiful a door at Caistor, and the remains of another were at Hunstanton. At both Faringdon and Uffington are Early English doors, covered with rich scroll-work proceeding from their crescent hinges and strengthening

pieces, which have numerous terminations in stamped rosettes and animal heads ; and the same stamps occur at Bisham and many other places among work of simpler design. All these are links in the development of the richly stamped ironwork produced later in the century by Thomas de Leghtone, and show that in England the use of stamps crept in gradually, as soon as the smith began to make use of vegetable forms involving much repetition.

To produce stamped work, the smith had to strike the hot iron into prepared dies, as wax is pressed into a seal ; and by this means designs for ironwork could be executed with the same minute elaboration as in carving or stained glass. The secret of preparing and using steel or chilled iron dies was certainly known in England quite early in the thirteenth century, but a really lavish use of them appears to have been first made in France, where the secret must have been jealously kept, for, notwithstanding possible efforts of German and other smiths, it did not pass the Rhine. When once portions of hinge-straps were moulded in relief, the invention of stamps could not be far distant ; yet we meet with nothing leading up to them in France, unless it is in the Cottonian MS., "*Nero*," c. iv., in which a French type of hinge occurs consisting of a bundle of stems bound together and springing into a tuft of leaves at the end. These may, however, have been beaten out under the hammer like some of the same form at Rouen. Otherwise, as far as actual specimens go, the work suddenly bursts upon us in France in fully developed magnificence, and seems to have been closely bound up with the earliest development of the rich pointed architecture of the *Ile de France*. The typical thirteenth-century vine is generally used, but another trefoil or cinquefoil vine (as in Plate 21) often takes its place, and these are always mingled with rosette-like flowers and sometimes fruit. The lobes of the leaves are sunk, and the divisions representing the larger veins and the periphery are raised,

and the stems usually grooved as in Plate 27. Extensive use was made of it at Noyon Cathedral, in hinge-work for the presses, chests, and for the treasury and sacristy doors. In the neighbouring hospital was a unique paschal candlestick formed of a bunch of slender stems and leaves, charmingly fashioned into a tall open-work shaft, curling over at the summit in large rosettes and clusters of grapes. At Sens Cathedral it is used for the sacristy and treasury doors ; and at Rouen the same work is used for the hinges and decoration of the sacristy and the north and south transept doors. It was used for the great north door at Mantes and at Vézelay ; and the scrolls of a most graceful grille at Braisne, near Soissons, terminate in stamped leaves and grapes. The well-preserved chest, Plate 19, presents a typical example of the vine-pattern hinge in its simplest form. Though only a low grille to one of the crypt chapels now remains in the Abbey of St. Denis, stamped work was lavishly used there, according to Viollet le Duc ; for portions of two magnificent grilles, one almost a counterpart of our Eleanor grille, were figured by him as existing in the "*magasins*." Numerous fragments, both of grilles and hinges, exist in the Carnavalet, Cluny, and private museums, which are known or surmised to have come from the metropolitan Cathedral of Notre Dame, and at the first-named there is a large and perfect chest covered with stamped hinge-work of the vine pattern.

The work culminated, however, in the celebrated hinges still existing on two out of the three magnificent western portals of the cathedral (Plate 20). Each of the double doors is hung by three hinges and two strengthening pieces between, any one of them large enough to cover almost entirely an ordinary parish church door. The work is extravagantly rich, representing, it is supposed, the terrestrial Paradise, with its foliage sheltering innumerable birds, dragons, and other fantastic beings. The stems are deeply

fluted ; not, as stated by Le Duc, composed of bundles of rods welded together, but with wide and deeply moulded collars or staples, and richly tufted ends in the French style. The small human heads, the quatrefoil and sexfoil centres to some of the straps, and details in the treatment of some of the leaves and rosettes, are features quite unknown in England in work of this period ; but, on the other hand, much of the ornament is of the English vine-leaf and rosette type, and the dragons' heads are those of our Eleanor grille (see Plate 25). Each hinge and strengthening piece is a separate, independently designed work, complete in itself, with little reference to its neighbour, neither interlacing nor dovetailing, nor planned to any general scale. The designs differ so considerably as to destroy somewhat the general symmetry, and, though consisting of most florid scroll-work, each piece is so circumscribed within its own allotted share of space as to deprive the design as a whole of the freedom so eminently characteristic of work of this period elsewhere. In spite of these defects, however, these doors form the grandest and most colossal work of the blacksmith of their age, yet, though belonging to the central church of the Metropolis of France, not the faintest tradition of their manufacture exists, and their exact date is therefore unknown. A nation which began to treasure the names of its artists in metal from the days of St. Eloi can but ascribe this extraordinary production in iron to the devil, or to Biscornet, a skilled Burgundian smith of the sixteenth century. The latter fable took such hold, however, that another celebrated smith, Mathurin Jousse, writing in 1627, regretted that Biscornet had not divulged the secret of running iron as other fusible metals. No higher tribute could be paid than this confession by the most noted smith of the day, that he was unable to conceive that anything so rich could possibly have been forged, and that he was driven to suppose it had been cast by some utterly lost process. Nothing

being really known as to where or when they were made, several French writers agree in ascribing them to the latter part of the twelfth century, but it is difficult to regard them as earlier than about the middle of the thirteenth century.

It is remarkable that almost all this stamped work exists in the Ile de France, or in churches designed by architects of the Royal Domain of Philippe Auguste, and is met with nowhere else in France ; even the great cathedrals of Amiens, Chartres, Bourges, Laon, etc., being destitute of any stamped work of the kind. It lasted but a brief period, the excessive extravagance of the metropolitan *magnum opus* having, perhaps, rendered all rivalry impossible. Outside France and England such work is only met with in Belgium, notably at Liège, and was possibly imported. The fine hinge-work on the treasury door of the cathedral of St. Paul is very similar indeed to the designs used in England ; while the hinges of a press in the sacristy at St. Jacques (Plate 21), show the cinquefoil leaf peculiar to French examples.

The distribution of richly stamped ironwork of this type in England is interesting, and the specimens are so limited in number that they might well be ascribed to a single smith. Through the account of the Eleanor grille, so fortunately preserved, we are able to connect some of them with Thomas de Leghtone. That Thomas de Leghtone is rightly identified with Leighton Buzzard is fairly certain, since the hinges on the parish church door are of the same work, and the only other church doors similarly decorated are also in Bedfordshire—at Eaton Bray and Turvey. Of the remainder of the fourteen existing specimens of any importance three are in the Eastern Counties, at Norwich, Tunstall, and Colchester ; others at Windsor, Oxford, Lichfield, York, Chester, and Westminster. All the work has certain characteristics in common ; thus it is all formed of easy scrolls, flowing one from the other, and rarely completing a second whorl ; the leaves springing

from these grow almost invariably from the outer edge of the curve ; nothing but the vine is used, and the stamps consist almost solely of the asymmetrical thirteenth-century leaf, a trefoil, a bunch of grapes, and a few sizes of rosettes ; the same dragons' heads are introduced in all, and the collars or fastenings are alike.

A magnificent example is now on the inside of the east doors of St. George's Chapel at Windsor, having been removed from the Chapel of Henry III. (Plate 22). The design is a large vesica diaper filled with flowing scrollwork, profusely embellished with leaves and rosettes. This work, which dates from the middle of the thirteenth century, has been thought to be from the hand of Henry of Lewes, the predecessor of Thomas de Leghtone. Merton College, Oxford, possesses some well-known hinges, distinguished as the only ones of the stamped vine-pattern group in which the old crescentic form is the basis of the design: these may also be by Henry of Lewes. On the Chapter House doors at York the whole vine is represented growing from the root, which is prettily treated, to the top, where it overflows on one of the doors and falls trailing down on either side. A special feature in these are the dragons in high relief at the top, which may be relics of Danish tradition, and very charming, even when imperfect, are the open-work handles, recalling the basket-hilts of rapiers. On the aumbry doors at Chester (Plate 23) the grapes and dragons' heads are scarcely recognisable, and the work is so delicate that the smallest leaves are no larger than the finger-nail.* The west doors of Lichfield cathedral present an example of the vine design on a grand scale, the woodwork between the four hinge-straps of each door being covered by great foliated scrolls like the unrolling of fern fronds. When restored, the leaves, unfortunately, were made to spring from both edges of the scrolls, giving the new work

* Reproductions are in the Victoria and Albert Museum, nos. M. 1916-2 to 5.

a somewhat different character to the old. St. Mary's, Norwich, presents an example on a lesser scale, and introduces some small fleurs-de-lis in the design. One of the two cope-chests in York cathedral is covered with a bold scroll-work of the vine pattern with flowing curves ; beside it is the other of the same date presenting a perfect foil, the main lines being stiff and pointed, and ending in tufted flower-spikes, which were not produced in dies, but were rounded under the hammer. As the one is taken from the vine, the other suggests corn ; the second element of the Sacrament being doubtless represented to escape monotony, as we observe under similar circumstances at Sens. The three Bedfordshire doors are much alike and of inferior interest, but the treatment of the Tunstall door is unique, and seems to have no parallel in France. It consists of two narrow plain strap-hinges destitute of ornament, while the entire space between them is occupied by a most elaborate cruciform handle-plate of delicate branching scrolls ending in the usual leaves and rosettes (Plate 24).

The most important specimen of all, however, and the one by which we are enabled approximately to date the rest and to attribute them with certainty to an English smith, is the grille on the tomb of Eleanor of Castile, Queen of Edward I., in Westminster Abbey (Plate 25*). The records show that this was made by Thomas de Leghtone, in 1294, at a cost of £13, a sum equalling £180 of our money. It consists of eleven panels resembling hinge-work, riveted to the face of a plain rectangular frame, to which the arching or herse form was given, and surmounted by a row of trident spikes. Though no two of the panels are exactly alike, the easy flow of the vine pattern is apparent in nine of them, while the stiffer growth of the corn is conspicuous in two others, notwithstanding that the vine-leaf stamp

* A reproduction in wrought iron is in the Victoria and Albert Museum, no. 1888-425.

is used to finish them off. These two panels are further emphasised by the particularly small tridents which surmount them. The rich effect produced by this application of hinge-work to grilles is very successful. Tradition has unfortunately not preserved the form of the lost grille to the adjacent tomb of Henry III., made by Henry of Lewes, nor of the contemporary railings that are recorded to have been set round the Eleanor crosses.

Except the Eleanor grille, there is nothing certain as to the dates of the stamped ironwork in either France or England. Thomas de Leghtone may have visited France or become in some way familiar with French work, and reproduced it here. But it is at least as likely that he was commissioned to reproduce his superb Eleanor grille for the Cathedral of St. Denis, or, since Edward I. was then negotiating to marry the French king's sister, that French smiths were able to see and copy it. Pending more definite evidence, it is permissible to regard the rich and elaborate stamped vine-pattern ironwork of the thirteenth century as having been evolved in England, where its gradual development can be traced. We have ventured to attribute its sudden cessation in France to the over-magnificence of the Notre Dame hinges ; for fashion in working iron, as in everything else, had its ebbs and flows from rich to plain ; and that which no emulation could possibly equal, far less surpass, was let alone, since in France there seems to have been no attempts to rival or imitate them. This could not have been the case in England, for the great esteem the work was held in is shown by so many of the wealthiest establishments vying with each other to possess it. It must have ended with the death of Thomas de Leghtone, who appears to have carried the secret, or the manipulative skill, with him to the grave. Nor is it possible to doubt the great influence these designs had on English smithing. Efforts to reproduce them exist on several chests, such as at Malpas and Icklingham, which are profusely

covered with similar leafwork, but hammered without the aid of stamps. Other examples exist, as at Arborfield, Santon, Filby, etc.; while yet others, as at Wootton, Northfleet, Hunstanton, etc., though existing until recently, have now disappeared. Some of these known from imperfect illustrations may, like the Sempringham work, antedate the use of stamps.

We have seen that the rich stamped work held no monopoly either in England or France, and we must glance at the more unpretending styles of work which accompanied it; but as in a condensed history only the stirring events are chronicled, so in our record only the more striking waves of fashion can be described. Of these, perhaps the most noticeable is represented by the rather massive hinges on the west doors of Lincoln cathedral, which cannot be earlier than 1235. In these the crescent type is maintained, as in the older ones of Haddiscoe, though in a rather rectangular form, and with several scrolls springing off in the old style, but with their ends and those of the strengthening pieces finished off into rude flowers and leaves. Somewhat similar, but ruder, are those at St. Mary's, Rushden, in Northamptonshire. But the crescent form was obviously on the decline; its strength was no longer needed, and it was giving place to the earlier strap-hinge ending in easy scrolls or a cross. Thus we see at Oundle the strap-hinge preserving only a diminutive crescent; and at Spalding one with a very small crescent at the base, but reversed, and an even smaller one halfway, with scrolls at the end. Thus lingeringly the crescent drops out, until, in the fourteenth century, it is almost forgotten. Rich examples of Lincolnshire work are at Deeping, Lincoln, and Caistor: elsewhere they are much simpler, branch after branch of the ornament being apparently shed until nothing remained but the mere strap with foliated end. A coarser type, with shorter and much broader-bladed leaves, of the peascod character, is found in the south, great numbers

of examples still existing. The narrow-leaved type seems to have developed into the strap with cross end, and the broad leaf became a strap with a peculiarly broad-bladed and vigorous kind of lily-like end. It is impossible to describe all the varieties to be seen on church doors and parish chests. It must be remembered that at all periods, if no skilled smith was at hand, the simplest forms were put up with, very rich Norman doorways being often associated with plain iron straps. On the other hand, a gifted smith might often for a time revive richer styles that were generally obsolete; while changes of fashion would penetrate to the remoter counties in mediæval times with extreme slowness.

Precisely the same changes took place in France. The thirteenth-century hinges at Amiens, Troyes, and other cathedrals, and at Laon, which possessed no stamped iron, might be English, except that the forms are different and, on the whole, perhaps, of somewhat better design.

The history of ironworking in Germany begins at a later date than in either England or France. It would seem that, as heirs to the Holy Roman Empire, Germans cared nothing for decorative iron while Romanesque architecture survived. Bronze was their metal, and if we find a few doors with scrolled iron hinges, like St. Ursula's at Cologne, the designs are taken from across the Rhine. Yet even in the twelfth century we have indications of the national love for iron, which afterwards became so very pronounced. The magnificent hinges of Alsace, already described, were, it would seem, a perfectly spontaneous development, and the same form recurs on the tower door at Kaisheim, near Donauwörth. The twelfth-century hinges to the door between the castle and St. Magnus' Church at Brunswick present another original treatment. Each consists of eight scrolls springing from a central stem and ending in a single flattened cinquefoil leaf. The iron is deeply channelled, and a peculiar character is given

by the introduction of flat discs along the stem at the springing of the scrolls. There are also in Austria, at the Liebfrauenkirche in Wiener Neustadt, and in Friesach and Piesting, Romanesque doors covered with iron in the Danish fashion. These essays, however, led to nothing, and for the time the art went no further.

By the end of the thirteenth century pointed architecture was established in Germany, and the new style demanded, in its early developments at least, the use of decorative ironwork. The designs introduced were naturally those associated with the grandest expressions of Gothic ironwork in France, and were taken from the rich stamped work of St. Denis or Notre Dame. One of the most remarkable specimens is the grille closing the cathedral sacristy at Hildesheim. It is fashioned, as in French examples, of vertical bars filled in with C-scrolls ending in leaves and rosettes. The leaves and rosettes are, from their shapes, most obviously intended to represent the stamped leaves of the Ile de France, but they are beaten out thin and flat, and the sunk parts pierced right through, giving the work an entirely novel and rather Oriental effect. It is just the sort of rendering we might get from a smith set to work from a drawing without sections and unacquainted with the process of stamping. These pierced ornaments, produced apparently through a mistaken interpretation of the original drawing, were repeatedly copied by later smiths, and were the basis of one of the most persistent and charming features of later German smithing. We shall see, in fact, that the German school was entirely founded on an imperfect rendering of French types, owing chiefly to ignorance of the art of pressing hot iron into dies, as practised in England and France. Its rapid development was due to the efforts made in Germany to carry Gothic architecture beyond the limits of restraint and refinement imposed in France—efforts which led almost immediately to a general deterioration, betrayed by a quite

peculiar mannerism in the ironwork. Their constant recourse to natural foliage in architectural ornament no doubt led to foliated forms being made the basis of smithing throughout the Gothic period, though, down to the fifteenth century, the smith seldom went outside conventionalised forms of the vine for his models.

The number of examples belonging to the first and second periods of Gothic architecture in Germany—roughly from 1225 to 1375—appears, unfortunately, to be limited, for though many portfolios of illustrations of German ironwork have been published, they deal almost exclusively with the sixteenth to the eighteenth centuries. One of the grandest among them is found on the doors of St. Elizabeth's Church, at Marburg, near Cassel. These date from 1283, and the ironwork is regarded as contemporary. The hinges are broad tridents, in form somewhat like those of Lincoln, and certainly borrowed from the crescent; the upper ones have a fantastic central strap and three points ending in smaller tridents, bearing altogether over fifty cinquefoil vine leaves of the French outline, as seen at Liège (Plate 21); while the lower, of simpler form, carry about forty vine leaves of the more traditional thirteenth-century outline. A flowing border of the same is made to follow the outer edges of the doors, while a magnificently interlaced quadrupled cross fills the space between—the precursor, perhaps, of the interlaced work used so largely later on. In the hinges at Magdeburg we have another of the thirteenth-century renderings of the vine occasionally seen in France, in which the leaves are ovate, narrow, and deeply indented. The design is the strap with branching scrolls, the inner of which are prolonged on both hinges, so as to interlace over the centre of the door. A singular development is shown in the hinges of Schmalkalden, near Coburg, in which all likeness to the original vine is lost, the leaves, so far as they are visible under the great round-headed

nails which transfix them, being merely cleft at the point ; but to compensate for this, and to identify the plant, we have very realistic tendrils. Other variations of the vine are to be seen at Mülhausen, Eschwege, St. Severin at Erfurt, etc. ; and a remarkably elongated and deeply cleft one at Treysa, near Marburg, became, later on, in the Church of St. Martin, at Bâle, exaggerated till it bears the likeness of a wheat-ear. This form of decoration may be seen on a reproduction of the Tabernacle door of St. Sebald, Nuremberg, about 1320-50, at South Kensington (Plate 26). The Museum fortunately possesses an original example of this type (Plate 27). The vine, as used in smithing, is indeed a protean plant, and were it not that the fruit and tendrils are so often introduced, it would at times pass beyond our powers of recognition. Side by side with the foliated hinges were others of plainer scroll-work, and scrolls and fleurs-de-lis were often mingled in the designs with the foliage, which in time developed new characters.

The close of the thirteenth century marks, roughly speaking, the end of a period which we may properly define as that of genuine blacksmithing. The texture of iron, it is well known, becomes loosened by heat, and, as it softens, bars will droop and curl into scrolls under a relatively slight impetus, this property rendering it so facile a metal in the hands of the smith. When hot it can be welded, separate pieces adhering firmly together if hammered or pressed, and the rich and intricate effects we have seen were mainly produced by this means. The welding point is the highest degree of heat the iron will bear without burning and disintegrating, and its management requires skill and dexterity. The distinction between the blacksmith's art and almost every other is that whatever he intends to do he must do quickly. He must strike while the iron is hot, for as the fierce glow fades into dull red its plasticity is departing. The quick and decisive treatment of iron while it is transiently in a plastic condition must be regarded as the

true art of the blacksmith, and of necessity leads to vigorous and masculine efforts. The tools of the smithy proper consist merely of hammer and anvil, forge and bellows, tongs and chisels. In the work we have described, small objects such as hinges, however complicated in design, were nearly always welded into a single piece, while in grilles the several pieces were fixed by driving holes through the heated iron and riveting them together, or more commonly by binding the pieces round with hot wisps of iron called collars.

In appreciating this old work, we must not forget that, while the smith of to-day can buy his iron ready rolled into a thousand different sections, he had then to beat out every section with his own hand. Hence old ironwork possesses interest and attractions which few modern examples can equal, for scarcely any piece of old iron fails to please. A great deal of the modern ironwork introduced into cathedrals and churches has been designed with little reference to the properties which should determine its artistic treatment, and will, as our taste improves, probably be swept away; but even where some happily surviving antiquity has been copied it needs no antiquary or specialist to become at once conscious which is the old and which the new. The explanation is simply that the olden-time smith cut a piece from his shingled bar which he judged by the eye would beat out into a rod of the required length, or curl into a scroll of the desired form. More or less sufficed for him, and by his method of work he produced an irregularity and play in even the most monotonous designs, which is artistically charming to us, but which was possibly a source of reproach to himself. The designs are so practical, yet so rude, that they were obviously produced by the smith who executed the work. Even if directed by a designer, the smith's capacity must have been thoroughly gauged, and the technical details left well within his powers. It appears that, when no specially skilled smith was available,

only the simplest forms were used, the capacity of the workers controlling the demand. When some unusually important occasion demanded a particularly fine work, it was not the man with local claims who obtained the commission, but the best man, and we find smiths fetched from a distance, as from Leighton or Lewes, and maintained in London and elsewhere until the work was accomplished.

IV.

THE TRANSITION—FOURTEENTH CENTURY.

THE fourteenth century marks a transition period in the art of the blacksmith. The *Hauptperiode*, as the Germans would call it, has passed, and the smith no longer relies exclusively on hammer and heat to produce his effects. He begins to deal with iron while cold and stubborn, the results of the two treatments, unless the metal used is too thin to offer resistance, being as opposite as can be. File and saw, vice and drill, are called to his aid to shape the pieces, and they are bolted or riveted together without heat, or tenoned and morticed as in joinery. Sheet iron pierced into tracery, or cut and hammered into the shapes of leaves and flowers, begins to enter into the compositions, and the art of the blacksmith branches into those of the locksmith and armourer.

In order to understand how this change came about, we must now turn our attention to regions we have thus far neglected.

The East had been celebrated for its skill in working iron from the earliest times, chiefly for the manufacture of weapons and armour. If little use was made of iron in architecture, except as dowels and girders, it was from no lack of skill. In India iron was largely used fifteen centuries before the Christian era, finding its way to Western Asia and Europe through Persia. India, indeed, presents us with the most extraordinary forging of antiquity, of a magnitude never attempted even in England until the introduction of steam. This, the far-famed iron pillar of Delhi, standing in the centre

of the court of the Kutb Mosque, is a solid shaft of malleable iron, twenty-three feet eight inches in height, with a diameter of over sixteen inches at the base, and fully twelve inches at the capital. The dedicatory inscription gives the date as A.D. 415, and from its vast antiquity it has become the object of many traditions and much veneration. The shaft, except for a foot or two near the base, is smooth and round, the contact of the greasy bodies of the Hindoos who make pilgrimages to it, and whose custom is to climb it, having probably preserved it from rust during the fifteen centuries it has been exposed to the air. The cast in the Indian Section of the Victoria and Albert Museum shows that the capital, which is three feet and a half high, and the inscriptions upon it, are still as perfect and sharp as when first carved.

It was, however, the Saracenic art and architecture which penetrated to Europe from Western Asia, and, following the trade routes, appeared in Northern Italy. All architectural traditions had been derived previously from the ruins of the Roman Empire, and neither in Roman architecture nor in its descendants, Romanesque and Byzantine, was there much scope for the employment of decorative ironwork. In the Christian art revival, the traditional love of costly materials was, moreover, maintained, and for rails and screens we find, instead of iron, the richest marbles and bronze and even silver employed, in St. Sophia and St. Peter's. The use of iron as a decorative architectural feature, in fact, appears to have originated in England, and to have spread from England to Western Europe and Spain. But it was seldom admitted into Italy—a sun whose rays deigned to illumine the outer world, but which was not itself receptive.

The Venetian Republic, however, a trading organisation, with many points of resemblance to our East India Company, was, fortunately for Italian art, what the leaves are to the tree. Freely exposed to the outer light and air, it performed the

functions of absorption, transpiration, and assimilation, by which the tissue of the parent art stem was nourished and renewed. But Venice, from its position, was far more open to the influence of the East than of the West, and thus, though the first use of decorative ironwork to be found in Italy is on Venetian soil, its forms are wholly independent of either English or French influence. The first attempts consist of a few grilles, copies (for the sake of strength) in iron of the pierced marble so extensively used in Saracenic architecture; and emanating from our instructors in geometry they are naturally geometric in design.

Examples of these exist at St. Anastasia's, Verona, and St. Mark's, Venice, which are probably as old as the thirteenth century. They are made of an iron framework grooved to receive pierced sheet-iron panels, and were evidently produced with great labour. Also they appear to have been soon abandoned, and the geometric design arrived at by the simpler process of riveting straps of iron together. They were probably gilded, and we occasionally see them thus represented in paintings by old Italian masters. Still later the geometric treatment was less rigidly adhered to, and Mr. Parker, of Oxford, possessed a sketch from Verona, in which quaint animals and quatrefoil ornaments are cut out of the sheet metal and riveted between the geometric lattice-work. By an easy transition, armorial badges and cyphers took the place of meaningless ornament, and we have an example in the Palace of Perugia, made of broad flat straps riveted so as to form rectangular spaces, in which are rampant griffins and coroneted A's within circles. It is inscribed, "Gull. Rufinelli me fecit, 1338."

It is probable enough that the use of the circle in grilles, very likely taken from the roundel glazing of St. Mark's, suggested the far more decorative quatrefoil—a form in singular harmony with the Italian pointed architecture, by

that time at its best. Grilles of circles and of quatrefoils are, indeed, to be seen in juxtaposition at San Miniato, Florence. The happy effect of those constructed of quatrefoils was immediately recognised, and for an appreciable period no other design seems to have been used.

The best known examples of this work are probably the grilles to the Della Scala tombs in Verona. The richest of the many designs is round a tomb which must have been erected soon after 1375, but the outer enclosing grille may date back to the very end of the thirteenth century. The evolution of the quatrefoil grilles from the earlier plate grilles is clearly shown in these Della Scala railings, part of which is made from plate metal. We can well imagine the surprise so inferior a construction would occasion in the minds of travelled English or French men, and we can hardly wonder to find it soon abandoned, and the remainder forged from bars in the English and French fashion. The plainest of the designs is merely the quatrefoil tied together, with a sharp spike welded in where the segments join. In the richer designs the spikes and the loose ends of the collars or ties are beaten into leaves, and the ladder, the badge of the Della Scala, is introduced, either in an octagon or a circle, in the centre of each quatrefoil. There is sometimes an additional border of leaves, and a leafy cresting with arching tridents for protection. Grilles of this type were soon associated with the magnificent cathedrals of Siena, Orvieto, and other buildings erected towards the close of the thirteenth century. They are formed in a massive-looking and richly moulded framing, really built up of plates of iron dividing the grille into rectangular panels filled with the quatrefoil ornament. There is usually a rich frieze of foliage and armorial bearings of sheet iron, commonly surmounted by a defensive and foliated cresting. The earliest dated example is at Orvieto, made by Conte di Lello in 1337. In this there are but four quite simple quatrefoils in each panel, and the frieze is of

ivy or vine leaves with a pierced shield of arms, the introduction of the latter being a feature almost peculiar to Italian ironwork at this time. The cresting is of slender fleurs-de-lis studded with spikes and lofty finials, with two tiers of very elegant cusped foliage surmounting the vertical divisions of the framework. The grille at La Santa Trinità, Florence, is an adaptation of this with much larger panels, containing thirty



FIG. 28.—Frieze of the grille in the Palazzo Comunale, Siena.

quatrefoils instead of four, and without the cresting. The vine leaves in the frieze are more numerous and cut up, and the quatrefoils have spikes and little leaves where the segments join. This is again almost reproduced in one of the grilles at Prato. Another adaptation from the same original is in the Palazzo Comunale at Siena, finished in 1445, in which the interspaces between the original nine quatrefoils of each panel are filled with subsidiary pointed quatrefoils. The cresting

is of straight spikes intermixed with an occasional flower-spike like an agave or yucca bloom, and a lotus-like finial over the vertical bars of the framing. Underneath is a frieze of the richest beaten foliage, introducing shields and the wolf of Rome in the panels (Fig. 28). The filling of these interspaces may have been suggested by the grille to the Campo Santo of Santa Croce, at Florence, in which the quatrefoils are placed within circles. There is a further development of this work, much later in date, in the cathedral at Perugia. These quatrefoil grilles remained in vogue certainly down to the beginning of the sixteenth century and were revived in the seventeenth and eighteenth. Susceptible of an endless variety of treatment, they still retained the main features in common. Richer developments of the same design were carried out in bronze or with carved and inlaid marble framing and bronze panels.

Perhaps the most interesting of the quatrefoil grilles is the elaborate and perfect specimen at Santa Croce, Florence, above mentioned, dated 1371. It is divided into rectangular panels, like all the rest, by a massive-looking framework, each panel containing six quatrefoils within circles, and with the subsidiary ornament in the interspaces. The meetings of all the segments are beaten into leaves, and a simple cornice, with a dedication to the Virgin in black letter, takes the place of the richer frieze, and there is no defensive cresting. The remarkable departure in this grille, however, is the gate, which is a reproduction in iron of a richly traceried Italian Gothic window of the fourteenth century, copied perhaps from the church of Or San Michele. Most of the iron used has been punched into the forms of caps, bases, and mouldings by tools, as well as chiselled and filed, and the twisted pillars are ingeniously composed of several pieces of moulded iron. The tracery is quite out of scale with the quatrefoil work, which is rendered coarse by comparison, and,

whether from this circumstance or the great difficulties in producing it, the fashion did not spread in Italy. Such an essay at a purely architectural treatment of iron was, perhaps, the inevitable outcome of the richly moulded and built-up frames and transoms of the Orvieto grille. A light example of purely architectural treatment is in the Museum (Plate 28). But it must be remembered that Italian ironwork, from its very inception, partook more of the character of joinery and carving in iron than of smithing, and it was not till late in the sixteenth century that it emancipated itself from its old traditions.

In France geometric design, the basis of Gothic architecture, was already beginning to be applied to ironwork.

The choir aisle gates from Rouen Cathedral, now in the Rouen Museum, show one of its earliest introductions in grille-work. Each door is formed of half-round iron bars crossing diagonally, with other bars intersecting the spaces at right angles, and stamped at the ends into leafy terminations. Every triangle thus formed contains a looped scroll, finishing alternately in stamped heads and rosettes, with a simple tracery in the eye of the loop. There is some apparently later work at the bottom of the doors, but the trellis design at least must be late thirteenth or early fourteenth century work, presenting, perhaps, the earliest example anywhere of flat iron tracery applied to grilles. This introduction of tracery and sheet iron eased the smith, and had most important results. Henceforth richer effects were sought and obtained with less labour, and the work was pieced together by rivets, instead of by welds and collars which required heat. A small grille formerly in St. Denis, figured by Le Duc, affords an interesting instance of the new construction. The sharply bent scrolls of which it is composed have their ends beaten thin and cut up into quatrefoil leaves and are riveted to the upright bars, which are themselves faced with sheet-iron

strips, on which a slight ornament is punched. These changes in design and construction, slight as they appear, herald an entire revolution in the craft of the smith, who, no longer relying exclusively on the forge and hammer, has to adopt the tools of the armourer and locksmith. The irresistible set in the direction of architectural and geometric design is next exemplified in a fourteenth-century grille in the cloister of Le Puy-en-Velay. It is composed of vertical bars, hammered at the ends into caps and bases, and with sheet-iron crockets and terminals. The caps and bases are produced by the hammer without the use of the file, and the sheet ironwork is still welded, and not riveted—processes soon afterwards abandoned. The same cathedral possesses a beautiful geometric grille of a richly diapered design. During the fourteenth century grilles made of small bars threaded vertically or diagonally through each other were usual in France. These are sometimes enriched with pierced plates and borders, as in a window grille in St. Etienne, Dijon. Geometric design is the basis of these, and of such scroll-work grilles as the one in Notre Dame, Paris, surmounted by prickets, or one figured by Le Duc from Rouen. The choir gates of the Collegiate church at St. Quentin are partly filled with looped scrolls, but also introduce panels of open quatrefoil work and of sheet iron. Designs of quatrefoils seem to have been greatly appreciated; many instances are to be found of grilles formed of small quatrefoils in squares, or in circles, or of circles within squares. Some have the cusps shaped into points more or less enriched, and one remarkable window grille has the bows of the quatrefoils united by passing through jesters' bells. The beautiful screen at Langeac, in which the quatrefoils are arranged diagonally, so that there are no considerable interspaces, is a superb example of fourteenth-century ironwork; and an Italian look is given to the framing by twisting the bars and decorating them with rosettes, while the Italian cresting

is rendered by spikes growing through tulip-shaped flowers, with shields on the main standards.

As we have seen, examples of rich window grilles, though so rare with us, abound in France. Two splendid late fourteenth-century specimens at Troyes cathedral, consist of bars rendered more defensive by their decoration of scrolls and hooks and spinous leaves. Another finely decorative double-window grille, also at Troyes, is overlaid with pierced bands, battlements, and rosettes, and possesses a richly crocketed top. A fine fifteenth-century grille of trellis-work, almost hidden by the beaten foliage, tracery and pinnacles which enrich it, has been figured from Nancy. Numerous window grilles of a more severe type also exist, with the ends of their vertical bars beaten either into tufts of spiny leaves, fleurs-de-lis, bunches of lilies, or tridents, and the intersections of the vertical and horizontal bars often concealed by flowers or rosettes. One, said to be from the house of Jacques Cœur, at Bourges (Plate 29), now in the Musée Le Secq des Tournelles, Rouen, has the vertical bars opened out to form the outline of a heart.

In England, the fashionable geometric treatment was chiefly applicable to grilles, but our churches have been so entirely swept out and gutted of everything not actually structural, that it is impossible to tell to how great an extent these had been introduced. Hardly any examples remain, except in cathedrals, and modern restoration has removed much from them that even Puritanism had spared. The oldest indications of geometric grilles in this country are the iron supports to the leaded windows in Canterbury Cathedral. Their forms are varied, and dictated by the designs of the windows which they follow. Their presence is no doubt due to the French architect, William of Sens (who was killed by a fall from the scaffolding in 1179), since plain stanchion bars were generally used in England for the purpose. In France

the use of such guards was extensive, as at Chartres, Le Mans, etc., but they did not always absolutely follow the lead lines, as we see in the celebrated grille to the rose window of Notre Dame, Dijon. These, perhaps, belong rather to the domain of constructive ironwork which was in increasing use, as proved by the accounts of Notre Dame and the Sainte Chapelle in Paris. A decorative geometric grille to the chantry of Duke Humphrey of Gloucester in St. Albans Abbey is of early form, but dates from somewhat later than his death in 1446. (Plate 30).^{*} It is divided into numerous rectangular panels, filled with a network of small half-round bars, only half an inch in diameter, which cross each other diagonally and at right angles in alternate panels, and are pinned together at every intersection. A border of sheet iron pierced in quatrefoils as at Lincoln forms an appropriate cornice. It is interesting as the only example of a trellis grille in England. We are also fortunate in still possessing two of the quatrefoil grilles so frequent in France. A pair of gates (Plate 31), formerly in Chichester cathedral, have found their resting-place in the Victoria and Albert Museum; they are of similar design to those at the entrance of the Lady Chapel, and are said to have been parts of the Arundel screen beneath the Rood Loft, erected about 1478. They are made of bars neatly halved where they intersect, forming a number of small square panels, each framing a plain quatrefoil; a novel feature in English work is that they are put together, as in joinery, by pins or rivets, without the use of iron collars or welding. Some small panels at Wells, now dropping to pieces, show remains of similar quatrefoils arranged with the cusps vertically instead of diagonally, so that the interspaces are reduced; they have no rectangular dividing bars, and the quatrefoils seem consequently to have been welded at the cusps,

^{*} A reproduction in wrought iron of part of this grille is in the Victoria and Albert Museum, no. M 1914-15.

instead of merely bent over as at Chichester. In Salisbury cathedral there are some rude grilles in the choir, made of flat iron straps, about three-quarters of an inch wide, forming a rectangular framing, containing rough pointed quatrefoil with the cusps perpendicular. Some identical work has been made up into external gates at Christchurch, Hants; and the smith to whom the work was entrusted remarked that they were put together as if a carpenter had made them of wood, that is by halving the bars where they cross, and letting the cusps into a mortice-hole in the bars.

An early example of iron joinery closes the entrance to the choir at Canterbury (Plate 32). It is of simpler construction, consisting merely of long notched straps of iron, about half an inch thick, placed vertically, with other similar straps crossing them diagonally, and halved and riveted so as to form a rich hexagonal diaper. It dates from 1303. The same design, but in wood, occurs at Luxeuil, and has been sketched by Le Duc.

It is very obvious that the smith had no hand whatever in the production of such designs as these, and even in their execution his part was quite subordinate, for they are little more than joinery executed in iron. His interest in an art in which his share was but mechanical naturally declined, and by and by fell off altogether, and, except for military purposes, smithing as a fine art became almost extinct in England for a couple of centuries. Yet it could only be dormant, for so long as men rode armed into the field, and trusted their lives to helmet and cuirass, there could be no real lack of skilled workers. The demand for smith's work remained, but of a ruder and more utilitarian character, as seen in the strongly barred windows, such as those of New College, Oxford, and the defensive trident cresting to the chantry screen at Winchester cathedral, both built under William of Wykeham, surveyor to Edward III., who might have indulged in rich work had

it been in vogue. In this reign we read of an extensive use of iron at sea, for the ships of the French fleet, in preparation for the battle of Sluys, were bound together with massive chains, castles, bretaches, and bars; but a pretended flight of the English caused them to cast loose, and perhaps changed the fortunes of the day.* Chaucer's description of the Temple of Mars, "al of burned steel," shows that it was possible, at least, to imagine that iron could be used in masses in the time of Edward III.

"The dores were alle of ademauntz eterne,
I-clenched overthwart and endelong,
With iren tough; and, for to make it strong,
Every piler the temple to susteene
Was tonne greet, of iren bright and schene."—

Knights Tale.

The most essentially English development of smithing is seen in the tomb-railings, formed of plain and massive vertical bars, of which our cast-iron spear-headed area railings are the descendants. While in foreign countries they were endeavouring to retain beautiful lacy designs for their grilles and tomb-rails, and to overcome the assailable weakness of these by elaborate defensive crestings, we were going straight to the point by introducing a rail constructed of vertical bars, with no horizontal bars or other filling between them to afford a foothold. Beauty was made subservient to practical utility in a way that at once brought such railings into almost universal use; so that no monument of any pretension was left unguarded by them down to the close of the Tudor dynasty. Sketches of Westminster Abbey, or Canterbury cathedral,

* Roger of Wendover states that in 1217, in the reign of Henry III, the English fleet under Philip D'Albiny comprised galleys beaked with iron with which they pierced the ships of their adversaries and sank many of them in an instant. Geoffrey de Vinsauf also speaks of Richard I.'s galleys sinking the Saracens' ships with their spurs or beaks of iron.

published before the wholesale removal of these railings during the first half of the nineteenth century, present vistas of cage-like bars, which, seen in perspective, completely concealed the tombs they protected. The date of their introduction is probably that of Edward I., but none now exist older than the end of the fourteenth century, though they possibly supplanted an earlier form in which horizontal bars were numerous, and of which illustrations exist. The oldest monument in which they remain is the tomb of the Black Prince at Canterbury ; but since, among the minute directions left in his will for the construction of this monument, there is no mention of any grille or rail, it appears probable that they were not added until the monuments of Henry IV. and Archbishop Chichele were completed ; for the railings to all three seem by the same hand. In these the vertical rectangular bars are placed with the angle to the front ; there is a heavy battlemented cornice, and six tall turret-like buttressed standards, originally destined, perhaps, to hold tapers. The cornice is decorated with small stamped lions' heads and fleurs-de-lis ; and it became customary to enrich it with crests or devices. The archbishop's tomb and rails were put up in 1440, four years before his death. The vertical bars in other cases are carried upwards and sharpened into points, like the stakes of a stockade, or barbed like arrow-heads. An example of the former guards Archbishop Langham's tomb, and is the only original one remaining in Westminster Abbey, though there are parts of several others in the triforium. If contemporary, it would date about 1376, but the railing may be a protection added at a somewhat later time. In the Fitzalan tomb at Arundel, 1415, the standards are greatly enriched with crocketed finials. Sometimes a richly traceried border of sheet metal in several thicknesses took the place of the battlements, or an inscription between twisted fillets replaced them, as in Dr. Ashton's tomb in St. John's College, Cambridge.

This, dating from 1502, presents the earliest instance of the introduction of crests of the founder surmounting the standards, afterwards a very usual feature.

A singular departure from the normal type is that of the rail to the tomb of Sir Thomas Hungerford (d. 1411),* in the chapel at Farleigh, Somerset, which has horizontal bars hidden by richly decorated straps, and foliated ends to the vertical bars, and especially to the standards (Plate 33). The tomb of Bishop Beckington (d. 1464), at Wells cathedral, (Plate 34), has a similar railing, but still more decorated, with particularly massive and richly wrought turret-like standards, with battlemented finish. Examples of all these railings are numerous, and would form an interesting study, but their claims as works of art do not justify further attention here. The elaborate work put into the cornices shows that this form of rail or grille was not adopted through economy; and, indeed, considering that the appliances at the smith's disposal were very limited, it is not easy to imagine any more difficult and expensive task than the production of such massive, well-finished, unwieldy bars, and the still more massive standards. A very little study shows us that this type of grille was not selected because it was admired beyond any other, but solely on account of its offering the best means of protection. Whenever any doorway or opening in masonry that could be entirely filled required a grille, it was not formed of upright bars. Besides those already mentioned, we have the beautiful chancel screen in Arundel Church (Plate 35), with its tiers of small and elegant pointed arches, and the chapel grilles at Ely, to prove that practical considerations and not taste dictated the railing form.

The fifteenth-century grille in the Museum (Plate 36), taken out of Snarford Church, Lincolnshire, is a unique specimen. It probably occupied a position similar to that of the Eleanor

* Probably erected after 1464.

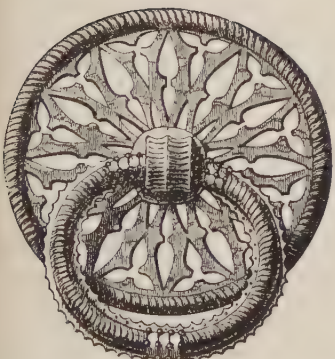
grille, protecting an effigy. The supports are finely wrought standards, reaching to the ground and surmounted by finials. The grille is composed of twisted vertical bars, with a pierced quatrefoil border below, and a border with inscription and a defensive cresting above of richly worked lilies, and fleurs-de-lis, with trefoils of vine at either end.

The plain grilles and tomb-rails so usual in England seem to have been in little favour in France. Some, however, in the cloister at Toulouse are of massive upright bars ending in dragons' heads and fleurs-de-lis, fine in workmanship and imposing in effect. An early illustration makes it appear that the choir grilles to the Sainte Chapelle, Paris, were of upright bars, bound together by the iron wattlework still to be seen in some grilles in Belgium, the idea of which may well have been taken from the then fashionable trellised hedges which particularly abounded in the gardens of the Palais de Justice. Few plain-bar grilles are now seen in the churches of France, for it seems to have been less customary to fence in effigies and monuments than in England.

The change in fashion was even more immediately injurious to door furniture, scrolled ironwork almost at once giving place to moulded carved wood, with plain iron straps, so that the calls on the smith in this direction were restricted. The door-handles and escutcheons show the utmost variety of treatment, and are often beautifully finished, their broad surfaces and edges being pounced, pierced, lined, notched, serrated, and pinked; the old traditions of smithing peeping out in dragons' or dogs' heads biting at each other or at the spindle, and the newer fashion being manifest in occasional armorial devices. The back plates are still more diversified, being either simple discs of sheet iron notched and lobed round the margin, and bossed out in the centre, or more or less fancifully pierced with crosses trefoils, key-holes, etc. (Figs. 29, 30). The knocker (Fig. 30) from Stockbury in Kent has a plate of this kind, while the

hammer is of the well-known form, based on a knightly spur, of which examples abound.

Richer examples combine sheet iron and forging, the plate being reinforced by stout circular bands, sometimes connected by crossed-bands, which are punched and filed into frets, crenellations, or vandyked edgings. Most beautiful specimens



D. 2. 14

FIG. 29.—Handle with pierced tracery, from Stogumber Church, Somerset. 15th century.

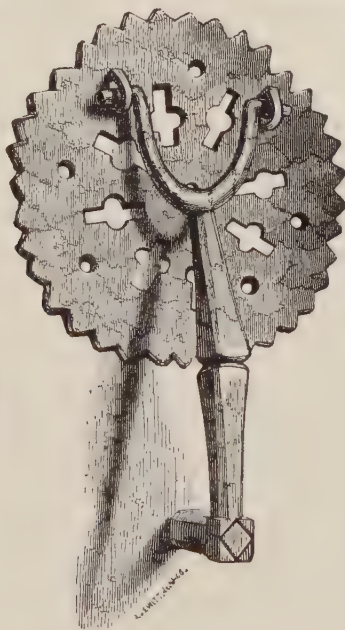


FIG. 30.—Knocker from Stockbury, Kent.

occur at Cirencester (Plate 37), and at Dickleburgh, Martham, Eye, etc. Sometimes the handles associated with these plates are rings, decorated or simple, or stirrup-shaped, or rarely interlacing knots. Occasionally the plates of attachment extend the length of the handle, and are richly pierced. Examples of these are to be found, attached to chapel and chantry doors, in most of our cathedrals. The escutcheon

plates, too, are of endless variety. Some are merely pierced rectangular or polygonal plates, with fleurs-de-lis at the angles, as at Winchester and Chichester; but mostly their outline is founded on the shield, though this is often cut into such exuberant arabesques as to disguise its origin. One at Rendcombe, in Gloucestershire, has Arabic numerals* and figures engraved upon it, presenting their supposed earliest use in any work connected with building. Very remarkable, too, is the large plate at Hereford, with the initials and device of Bishop Audley, and a butterfly, in raised iron riveted to the plate. Similar plates are more rarely seen in France, but there are good examples at Cordes and Troyes. The examples, Plate 38, in the Victoria and Albert Museum are somewhat Saracenic, and from Spain: they are, however, of later date.

We meet very rarely with elaborately decorated hingework of the old English style in the fourteenth century, and then only in comparatively remote places. Interesting examples of such exist at Cley church in Norfolk; and others at Hunstanton, probably by the same hand, were figured by Digby Wyatt, but have now disappeared.

But though no longer splendid, hinges of the fourteenth and fifteenth centuries were still occasionally required to spread over the doors, especially those to a sacristy or treasury. The older forms are in these cases retained, but with far more refined drawing, as if the smith were no longer the sole designer. A perfect example exists on the south door of the south transept of Winchester cathedral, which seems to belong to quite the close of the fifteenth century. In this the termination of every scroll is a graceful fleur-de-lis, and the door is uniformly covered by the hinge-work. Still more elegant are those in which the simple straps terminate in a triple or even in a single fleur-de-lis. For graceful ease the example at

* Arabic numerals appear on English bells in 1495, 1505, 1516 and later. H. B. Walters—*Church Bells of England*, p. 293.

Great Casterton, Rutland, can hardly be rivalled, and the hinges to the door of the triforium in Westminster Abbey are models of elegant simplicity, in striking contrast to those of approximately the same form which were afterwards used. Besides the few door-hinges, there are many magnificent examples of this work on muniment and other chests, where protection was of more consideration than fashion. An interesting example of provincial scroll-work may be seen on a cupboard in the Victoria and Albert Museum, No. M 170-1917. It probably dates from the fourteenth century, and is said to have belonged to the last Abbot of Whalley, Lancashire. Similar work has been noted in that neighbourhood.

In France, as with us, the hinge-work became severe, and was reduced in even the magnificent Sainte Chapelle to mere straps of iron ending in fleurs-de-lis. The hinge-bands of Amiens cathedral are straps dividing into three branches, each ending in three clusters of tongue and scroll ornament. At Notre Dame, Châlons-sur-Marne, they branch into very unusually realistic leaves of different forest trees. Rouen has some rich hinges with fleurs-de-lis. At Coutances two of the cathedral doors and the doors of St. Pierre have deeply moulded strap-hinges, split at the ends, and bearing two stamped flowers. The same massively moulded straps form a diagonal trellis, covering the central door of the cathedral, and are fixed to the wood by the same stamped rosettes used as nail-heads. This work, which is very peculiar, also existed at the not far distant Mont St. Michel, and seems to be of the late thirteenth century. Some of the hinges at Bayeux are also peculiar, recalling early grille-work, though probably contemporaneous with the last. Unfortunately, the churches of France, as a whole, appear to have suffered even more than our own as regards their ironwork, many of even the grandest abbeys and cathedrals being destitute of any original work. Immense quantities of their spoils appear to have passed to the dealers

and thence to amateurs. A large part of one of the largest collections, made by M. Peyre, is now in the Victoria and Albert Museum. On the other hand, a few objects of iron have been preserved of which we have no representatives in England. The paschal candlestick in the hospital of Noyon has been already mentioned. Another of the fifteenth century, in the cathedral of the same town, has fine realistic flowers under the pricket. The thirteenth-century iron tripod, with canine monsters on the feet, and four lions' heads, now supporting a desk, from St. Martin's church, Brive, is of splendid character. Two others and two folding arm-chairs from Bayeux and Narbonne, all of the thirteenth century, were exhibited in the Trocadéro, Paris, in 1889.

The merits of English and French smithing during this period seem evenly balanced. In both countries it was one of retrogression, but on the whole it appears to have possessed more vitality in England, and, where there is a similarity of design in both countries, England probably led the way. It could hardly be otherwise in the distracted state of France, and it is a wonder that, ruined and dismembered as she was by the English invasions, any art survived at all.

The German smiths, however, kept plodding away and developing along lines of their own. To follow this development will take us slightly in advance, as we meet with no convenient break precisely where we need it. The richness of the hinge-work was fully maintained, and, though the vine continued to be the only recognised theme, some rich effects were obtained from combinations of scrolls and small fleurs-de-lis without any foliage at all. Such were the hinges to the Palace chapel at Marburg; and those at Oberwesel, Neukirchen, Kolin, etc. A group from Western Germany is illustrated in Plate 39.

The vine having now passed through numerous conventional forms in Germany, some of them as near to nature,

perhaps, as the skill of the blacksmiths could produce, settled in the fifteenth century into a flat lozenge-shaped leaf so deeply cleft as to form a distinct quatrefoil. The type seems peculiarly Rhenish, and is characterised by a multitude of leaves branching from straight or slightly curved and slender stems. There is often some attempt at pierced, traceried forms on the central strap, and earlier forms as well as fleurs-de-lis are frequently mixed with the lozenge leaves. A superb and unusual example occurs at Erfurt Cathedral, belonging probably to the middle of the fifteenth century, when the nave was completed. This consists of six magnificent scroll-hinges, bearing numerous vine leaves and tendrils, covering a large part of the exterior surface of the doors, whilst their interior is completely covered by a splendid diaper, rich in rosettes, leaves, and armorial bearings. There are good examples at Thann, Oppenheim, Caub, Zülpich, and Magdeburg; and, until 1844, there were four fine examples at Oberwesel in perfect preservation, but they were destroyed by the architect who restored the church. By far the most remarkable example of this work, however, occurs at Schloss Lahneck, on the Rhine, where there are hinges almost covering the doors, across which their branches are trained in the stiff manner of espaliers, and bearing in all some two hundred and fifty leaves.

So far it is perfectly obvious that the designs used for architectural purposes by the ironworkers of Germany were in their origin based on the rich stamped work of France. The general ideas, the use of the vine, and all the conventional forms it first appears under, the introduction among the leaves of the small fleurs-de-lis, and the sparing use of tracery in combination with them, are all characters derived from the French school of Gothic architecture. A beautiful native school of ironwork was in active process of development from this French source, when, somewhere about 1450, it was diverted in an entirely new direction in consequence of work then being produced in Flanders and Brabant.

V.

THE AGE OF THE LOCKSMITH, FIFTEENTH
AND SIXTEENTH CENTURIES.

THE honours of the third period of mediæval iron-working belong to the locksmith and the armourer. Heat was now applied only in the preliminary stages, and the greater part of the work was accomplished by the file and saw, or by embossing the iron, or, when the highest realms of art were reached, by carving the statuette or other decorative object from the solid. The direct productions of the forge and hammer were seldom admitted into the design. To work successfully in iron a combination of artistic perception with manipulative skill became more than ever essential, and, to be thoroughly accomplished, it was requisite to understand construction and planning, and to be an adept in the arts of the locksmith, the armourer, and the jeweller.

The English smith, discouraged by the change of fashion, or engrossed in the civil wars, had ceased to lead the way, and fashioned little but the rudest work. The French smith, more pliable than the English, and with his country at last relieved from invasion, was far from being so discouraged, and assimilated the methods and skill of the locksmith and armourer with his own. As a result, there emerged one of the most beautiful phases of ironworking that has been seen.

The use of sheet iron became general, and it was the custom to strengthen doors with thin interlaced bands of what we should call hoop iron, fixed to the wood by rosettes or decorated nails. One of these, figured by Le Duc, has the lozenge-shaped spaces left by the intersecting bands filled with a rich

pattern of sheet ornament ; and another from the abbey of St. Bertin at St. Omer, in which the plates are horizontal and overlapping, has edges vandyked in exactly the same pattern as the plate armour then worn. The hinges at the cathedral of Auxerre are long straps with thin vandyked edges. In some parts of France we find, at the close of the fourteenth century, hinges of sheet iron pierced and embossed into rich leaf-forms, extremely like the German work so familiar a century later. Instances of such hinges are given by Le Duc from the abbey of Poissy, in the Ile de France, and from a house at Gallardon near Chartres. A great many hinges were made at this time and in the fifteenth century, of several thicknesses of sheet iron, pierced to represent tracery, and riveted together in strong frames.

This use of sheet iron was coincident with a singularly rapid development of richly traceried grille-work. At first we notice small pieces, such as the guichet in the south choir aisle at Chartres, pierced in only one thickness ; but increasing richness of design soon demanded the use of three or four sheets of piercing superimposed. This kind of work is illustrated by the tracery border from a casket (Plate 44). Owing to its great beauty it has been much sought by collectors, and where portable sold to them for high prices. Thus a splendid flamboyant door, in private hands, was figured in Shaw's *Decorative Arts*, and two sumptuous gilt panels from the tabernacle of the church of the ancient abbey of St. Loup at Troyes, are figured in Du Sommerard's *Arts du Moyen Age*. A superb example, illustrated in Plate 40, is among the most valuable treasures of the Victoria and Albert Museum. The central figure of Christ with a chalice, of cast bronze, is placed under a projecting and elaborate flamboyant traceried and pinnaced canopy. Below is a shield of arms surmounted by a crown. The rest of the design is flamboyant and architectural, and of extreme richness.

Among the specimens of these refined and laborious productions still *in situ*, we may notice the panels in the sacristy door in Rouen Cathedral, with flamboyant tracery, and treatment of Tudor-like roses ; and the much finer examples at Evreux where the cathedral treasury is protected by a screen of wood and iron, the handles and locks of which are marvels of art, while the great press it contains has openwork iron panels, bolts, locks, hinges, etc., of the finest imaginable work. In all these grander works the crockets, pinnacles, and leading lines of the tracery are chiselled and filed from the solid iron in full relief, and the pierced sheetwork plays but a very subordinate part,

In smaller objects, such as locks and knockers, the Victoria and Albert Museum is especially rich, and in these an even greater degree of refinement and delicacy is reached, which is hardly surpassed by the contemporary work in gold and silver. So exquisitely wrought are the finest of the locks that over one thousand pounds has been paid for a single specimen. Splendid examples are to be found in all considerable collections of works of art. The best in design belong to the close of the fifteenth century, but they increase in richness during the early part of the sixteenth. The basis of the design of all is usually the flamboyant architecture of the period, with the interest centring in figures of masks, dragons, etc., and wrought escutcheons of arms which are freely introduced, chiselled out of solid iron. Even the twelve apostles under canopies, the Garden of Eden, and other scriptural subjects are found represented. One here illustrated (Plate 41) is in the form of a triptych, in the centre panel of which appears the Crucifixion, the left and right panels showing respectively the Annunciation and the Visit of the Magi. A second example shows four apostles beneath canopies and another is covered with elaborate tracery (Plate 42). The Cluny Museum possesses one representing Christ and the Twelve Apostles, under separate canopies ; while others exhibit the Crucifixion,

Last Judgment, etc. Others, less ecclesiastical, like the superb specimen bearing the arms of France and Brittany, made for Louis XII., are equally rich. These locks were originally affixed to richly carved presses, trunks, and doors, and their mechanism is careful, concealing bolts and key-holes with great skill.*

Richly ornamented rim-locks appear as early as the thirteenth century, the front plate being more or less decorated with scroll-work, ending in thirteenth-century leaves and animals' heads, while the back-plate, by which the lock was fastened to the door, was extended beyond the lock, and cut into leaves, animals' heads, fleur-de-lis, and other forms. It is interesting to find the cock's head and eagle among them, and that use was made of incised lines and twisted and notched mouldings. The bolts and latches were equally ornamented, and the mechanism simple and thoughtful. The style, with slight changes of detail, prevailed through the fourteenth century, the ornament being most varied, elegant, and appropriate. The knockers and closing rings were peculiarly artistic, nearly always representing some animal form cleverly forged, often with pierced traceried back-plates. The keys were no less varied and beautiful. It is unfortunately impracticable to give even a *résumé* of their distinguishing characteristics within the limits of the present work, and the differences between small objects of French and other origin cannot be expressed in a few sentences. The coffers of sheet iron, strengthened with straps carried from back to front, enriched with tracery, and with lids curved like a trunk, are invariably French. They all agree in having panels on the front and sides of more or less rich tracery, formed of thin pierced metal plates laid over each other with great neatness, with projecting pieces shaped like buttresses of two or three

* Some doubt, unfortunately, must always exist as to the authenticity of many pieces of this kind in the absence of pedigrees.

stages, those at the angles being lengthened into legs on which the casket stands. At this time nothing was beneath the smith, even the nails being of most varied and beautiful designs.

The illustrations in Plates 43 to 50 are taken exclusively from specimens in the Victoria and Albert Museum, many acquired in 1895 from the Peyre collection. In Plate 43, one figure represents a winged dragon which formed the hammer of a fifteenth-century knocker. Another illustrates a somewhat later hammer formed of a curving bar terminating in a dog's head and ornamented in front with a collar and a dragon of more finished work. The punctured bands were probably filled with silver studs. Plate 44 presents a pair of hinges of perhaps almost unique design. Plate 45 shows a quaintly twisted fifteenth-century door-handle, made of round iron, pivoting in a Satanic head, with ends finishing in dragons' heads and acorns; also a small lock entirely covered with geometric tracery, and with a pinnacled arch guarding the keyhole, an exquisite specimen of fifteenth-century work; the key is characteristic of the time and of France. Plate 46 represents two fine late fifteenth-century chest locks. In one the plate is edged on three sides with a cable moulding; the hasp now fixed to the plate is a dragon, and of the three handsomely worked vertical bars the two outer ones form the fixing staples, and the central one is pivoted to conceal the keyhole. The second lock is similar, but no organic forms are represented. The left-hand figure on Plate 47 has probably fastened an aumbry door and is now imperfect. It comprises a bolt worked between two staples, rudely incised, and in a sheath pierced with tracery; the handle is quaintly twisted. The other represents the front of a double lock requiring to be opened with keys of different sizes. It is simple but of fine character, and its former ownership is designated by the small crozier-head and shield.

Plate 48 shows two closing rings or door-knockers. The former ring is hexagonal, formed of short lengths of round iron interpenetrating like rustic wood-work ; the back plate is circular, of two thicknesses, with denticulated margins and pierced fish tracery. The latter has a handle similarly representing rustic work, but intertwined to form a crown of thorns ; the circular plate has a toothed edge and filling of flamboyant tracery in three thicknesses. The lock on Plate 49 has lost the hasp and the figure, no doubt of the Virgin, which concealed the keyhole and the decorated holdfasts. Each division is margined by a cable border, and what were the interspaces are filled with pierced inscriptions in praise of the Virgin. The forms of the letters deserve attentive study. It is French of late fifteenth or early sixteenth century date.

The examples of richly worked door-knockers (Plates 49, 50) are exceptionally good. The first is of the usual lizard type, almost universal in France, on a rich but restrained plate of fish tracery design pierced in two thicknesses, with cable borders. The second, a Spanish type, is a well-forged and chiselled ring with tracery design under a projecting canopy and over a plate of pierced foliated scroll-work between crocketed buttresses. The third represents one of the curious hollow-pierced and fringed crescentic handles much affected in Germany ; the circular plate is of intersecting tracery pierced in three thicknesses with cable border.

The ironwork of Spain in the mediæval period has no very strongly marked characteristics, but can generally be recognised, either through some traces of *Mudejar* ornament, or from its tendency to combine distinct French and German elements. In Romanesque buildings of Leon, Navarre, and Old Castile, examples of twelfth- and thirteenth-century screens are met with, identical with the earliest in France and England ; and, like the contemporary hinge-work, they appear to be of Anglo-French inspiration. A few keys,

weapons, and implements make it clear, also, that the older traditions had not ceased to survive in various parts of Spain ; and in the Moorish provinces the smiths are reputed to have been particularly skilful in the manufacture of cutlery and arms. That no more considerable use was made of iron, in the interior of buildings, until the fifteenth century, may be ascribed to the Oriental partiality for rich materials, shared at that time by Spain and the larger part of Italy.

Windows were barred with iron throughout the Peninsula from early times, especially in the old Moorish cities. Either plain bars or threaded lattice-work were used, especially in Portugal. The Casa Solar, at Leon, in which Alonso Guzman was born in 1256, is noted for a profusion of iron gratings and balconies. The Casa de las Conchas, in Salamanca, presents some good gratings in the *patio* or court, and two magnificent examples on the exterior ; these massive specimens not only screened and protected the inmates, but excluded the glare of the sun. We frequently find that, though the building is in the Renaissance style, the ironwork is purely Gothic in spirit ; it consists of plain and twisted vertical bars with horizontal bands of pierced inscriptions, together with rich foliage, armorial bearings, turrets of Castile and pilgrim shells of St. James, the whole presenting a splendid monument of Spanish dignity and grandeur.

Some of the work shows German influence, but many of the finest buildings in Spain were erected by French and Flemings, and their art has on occasions deeply influenced Spanish ironwork. The rich traceried effects, produced by piercing and superposing two or more plates of iron, so popular in those countries, were introduced into Spain, but the work is never so pure and refined as in France. No better illustration could be found than a fire-guard in the Louvre, which, with Flemish panelling, combines some *Mudejar* feeling in the cresting, and, in the lower border, a German pierced

pattern interrupted by turrets of Castile. Some tall candlesticks, wall-branches, fire-dogs, and other objects, are designed in the same spirit, but they are scarcely numerous. The hexagonal pulpit in San Gil, at Burgos, with its fine overhanging canopy, appears to be one of the best examples. The framework on which the iron is laid is of wood, and the whole is rich flamboyant. A still handsomer pulpit exists in the cathedral at Avila, in which most of the panels and borders are purely flamboyant, but mixed with some entirely Renaissance details, including the dolphins which help to support it on its slender stem. Though rarely Gothic, iron pulpits are as prevalent in Spain as the iron font-cranes in the Low Countries; they are generally found in pairs, fronting each other.

Hitherto scant reference has been made to the ironwork of the Low Countries. The Flemings must have been highly skilled smiths, but owing to their vast prosperity previous to the Spanish yoke everything was renewed, and there are relatively few buildings and little ironwork throughout the Netherlands older than the fourteenth century. Though the stamped hinges at Liége were doubtless imported, they had some influence on Flemish work. Except these, the grilles protecting the archives in the Halle de Bruges, which, though probably of the fourteenth century, are a light rendering of our Winchester grille, are almost the only ancient specimens in the country, and they seem to have had a curious influence on the Flemish ironwork of the seventeenth century. Some rude and massive strap-hinges, fringed with small trefoil leaves on stems, on the outer doors of the Hôtel de Ville at Brussels, may also be of considerable antiquity.

It is possible that, as England's supremacy in ironworking was slipping away, the rapidly growing and enterprising towns of Flanders and Brabant saw an opportunity. Anyhow, they became the home of the iron industry in the

fifteenth century. A century earlier, Bruges, Ghent, and Brussels were the recognised centres of art and commerce ; and the magnificence of the wealthy burghers exceeded that of any European court or monarch. Nor were other cities, Ypres, Louvain, Mechlin, far behind in industry or population ; while in the fifteenth century all were eclipsed for vastness of commerce by Antwerp, whose port received two thousand five hundred ships at one time, five hundred entering it in a single day. Ironwork was not a staple industry in any of these, except perhaps Brussels, whose workers in iron and steel during the fourteenth century are said to have been unsurpassed in Europe. We may certainly take for granted that whatever such essentially commercial towns produced would be exported to the accessible marts in Europe and influence the productions of even distant countries.

Flemish ironwork is interesting in many ways, not the least that it presents us with a multitude of objects that are rare in France, and seem to have been completely swept away by the Puritans and their successors in England. These embrace many objects used in churches, such as stands for tapers, hanging-lamps, clocks, fire-dogs, and book-rests, especially such as were portable. Numerous examples are painted with minute accuracy by old Flemish masters, and large numbers of the actual objects are still to be seen in buildings and museums. We have just seen that ironworking had reached its third and least vigorous stage in France and England—a stage marked in the French work by peculiar refinement of design. But transplanted to a new and virgin soil, it pushed back into some of the older, more robust, and forcible stages. Thus we find the brawny Flemish smiths revelling in the hardest manual labour. It is almost incomprehensible how the monster gun of Ghent, Dulle Griete or Mad Meg, weighing 16,803 kilos, and measuring nineteen feet in length by eleven feet in circumference, could have been

produced without modern machinery. Yet there it is, formed of welded coils in the first half of the fifteenth century, with the arms of Philippe le Bon stamped upon it. The great Mons Meg of Edinburgh Castle is another of these productions, commonly reputed to have been made in Mons in 1476 ; while a third Flemish leviathan is at Bâle, and yet others at Mont St. Michel. The vigour with which they threw themselves into the new industry is no less evident in the beautifully moulded constructive ironwork in the spires, etc., of Bruges, Ghent, and Antwerp ; and the massive rails in the market-place of Mechlin (by Jean de Cuyper, 1531) and Xanten. Nothing is more eloquent of the force put into the work than the singular hinges that cover a pair of early fifteenth-century doors of the Church of Notre Dame at Hal. Perhaps the older hinges of St. Paul and St. Jacques at Liège excited emulation ; at all events, we find these stamped hinges produced as a mere *tour de force*, since no others exist, and they seem foreign to the prevailing style, but they are of a massiveness and relief that is extraordinary and far beyond any produced when the style was at its zenith. It is interesting to find that, though the vine is still retained for the design, its rendering is quite new, the leaves being symmetrically cleft and spined like thistle leaves, while the bunches of grapes are oval and of about the size of a prickly pear. A face is stamped at about the centre of each leaf, and the hinge-straps end in massive fleurs-de-lis. The work on the left-hand door includes a large traceried lock, more than a foot in length, which must be contemporary with the stamped work, and is in design like our grille to the Chantry of Henry V.*

Smithing appears, however, to have been brought to its highest state of perfection in the Low Countries by the Matsys family of Louvain. The unique position occupied by the

* A cast of one of these doors is in the Victoria and Albert Museum, no. 1872-66.

father, Josse Matsys, is shown by the fact that he held the posts of architect and clockmaker, as well as blacksmith, to the municipality. Though, strangely enough, some of his most important works for the Hôtel de Ville have been allowed to perish, at least one authentic specimen remains in the font-crane of Louvain cathedral—a rich piece of traceried work remarkable for the particularly bold and original treatment of its leaves. A world-renowned work, the well-cover near the cathedral at Antwerp, dated 1470, is evidently by the same hand. It is very like the work of Josse Matsys; and the celebrated painter, Quentin Matsys, to whom it is popularly attributed, could not have been more than ten or twelve years old when the well-cover was completed. Legend perhaps confounds him with Quentin, second son of Josse Matsys, who was not born till 1466, and followed his father's calling. In this imposing work no use has been made of stamps. The canopy is carried by four clustered columns, supporting four cusped arches converging to a centre. What might be termed the roof of the canopy is a tangle of interlacing branches and leaves, intended probably for the vine, and a conventional flower which both droops to form pendants and soars upward into pinnacles. The whole is crowned by the figure of Salvius Brabo, in Roman costume, holding aloft a spear and the hand of the giant Antigonius, and the springing of the arches is masked by four smaller but more pleasing figures dressed in skins. The design, though mediæval in feeling, is executed with a grace and freedom not known in ironwork of the period, and, from the ambitious introduction of figures in the round, so rarely attempted by the blacksmith, together with the crispness and vigour of the beaten iron foliage, appears to have made a profound and lasting impression on the art. These well-covers must have been once common, though only one other example now exists in the Netherlands, at the Porte de Hal, Brussels. One formerly

stood outside the Hôtel de Ville at Antwerp. Perhaps the one at Dijon, like the neighbouring Jacquemart of Notre Dame, is of Flemish origin. This *Jacquemart*, a word of disputed etymology, is a large open iron belfry ending in a *flèche* with two quaintly costumed iron automata to strike the bells, and is known to have been made at Courtrai in the fifteenth century.

Almost as important, and far more numerous, are the ponderous cranes so conspicuous in many Belgian baptisteries. They range in date from the fifteenth to the seventeenth century, and those at Hal, Breda, Bois-le-Duc, Zutphen, Ypres, and Dixmude present a fine range of examples. The Victoria and Albert Museum possesses a copy in wood of that at Hal, which is somewhat sparsely ornamented with tufts of leaves and large fleurs-de-lis. Iron candelabra are also to be met with in most Belgian churches, consisting usually of a tripod foot and simple angular stem, broken by a knop or moulding, supporting circles, or sometimes rows of lights, stepped one above another. The circles or bars are furnished with spikes and sockets to receive the candles, and are attached to the stem by brackets, or hang from it by straps and scrolls. One at Ypres has its stem most gracefully and simply ornamented by trefoil leaves and fleurs-de-lis. Another, at Lierre, in which the candles are in rows, has a central spike, on which an extra seven-branched candlestick can be socketed in case of need. A Tournai example has three tiers pierced with quatrefoils, and is crowned with leaves. Magnificent examples, over six feet high, at Acren, and Chapelle-à-Wattines, Hainault, support two hexagonal bands pierced with the "Ave Maria" and surmounted with fleurs-de-lis, as well as sockets and spikes. The candle-bands in these are supported from the stem by traceried brackets with lilies, as well as connected by cusped and trefoiled straps. A single branch, perhaps one of a cluster, is illustrated (Plate 51) on account of the elegance and reticence of the design.

The well-known herse-light at Osnabrück, over seven feet high, is in the style of Belgian work. Its massive tripod foot and moulded stem support two spandrel-shaped brackets filled with tracery, on which rests a vertical triangle of moulded iron bars filled in with rose-pattern tracery and painted iron shields. On two sides of the triangle is a step-like arrangement of scrolls and spikes for fifteen candles, and on the foot are rings by which it can be moved. Most of these objects were probably for intermittent use, and are planned to carry very large quantities of tapers to enhance the grandeur of great religious ceremonials, when the numbers of lights were so vast as to be compared to the stars descended from the firmament. The permanent and votive coronæ, candelabra, and sanctuary lamps were in more precious metals, except in the brief period when wrought iron was intrinsically appreciated. To this period belong the splendid twelve-branched corona at Louvain, attributed to Quentin Matsys; the fine chandelier surmounted by the dragon of Ghent, in the Church of St. Bavon; the beautiful openwork corona for twenty-six lights at Hal; the no less charming chandelier at Zutphen, etc. A typical form of traceried iron chandelier in the Victoria and Albert Museum is illustrated (Plate 52). Associated with the candelabra, and of precisely the same workmanship, are the portable lecterns made on the principle of folding deck-chairs, with leather or pigskin tops (Plate 53). Though nearly always simple, the iron legs have generally nicely-worked mouldings, and sometimes flower-work, with finials shaped into heads or fruits. The book-rails are often richly pierced. There are beautiful examples at Hal, Tournai, Courtrai, and in many of the museums. Seats, stands, alms-boxes, and even pulpits, catafalques, and herse for church use, are occasionally met with of similar workmanship; all these objects having been originally decorated in glowing colours, if not partly gilt. Plate 54 represents a finely wrought andiron of the same

period. The churches of Belgium contain a great deal of their mediæval furniture, which includes most of the finest specimens of ironwork in the country.

Mediæval iron church grilles were, however, largely displaced during the Renaissance, and chapels and choirs were then almost universally closed by screens of carved marble and wood, or bronze and brass. The existing fourteenth and fifteenth-century grilles are typically Flemish, composed of massive upright bars chiselled to indicate slightly, but effectively, the carved caps and bases of stonework, and forming long linear panels with traceried arches. The grille to the baptistery at Hal is a good example in a severe style. Another is afforded by the window grilles from the treasury of the Hôtel de Ville, at Louvain, 1463, with the decorative addition of a band of imitation wattles in iron over the top of the arch. This feature is twice repeated in the handsomer and more important grilles at Breda. Purely protective grilles of strong bars drifted through each other, forming lozenge or rectangular interspaces, are found in Belgium as elsewhere ; but they are sometimes rendered decorative by the introduction of traceried designs extending over several interspaces, like those of the Hôtel de Ville of Louvain. Others with roses at every intersection, and a battlemented and spiked cornice, close the baptistery of St. Walburga, at Zutphen ; and at the Hôtel de Ville of Kempen, the plain rectangular barred window grilles have a highly decorated cresting and sides.

The stalwart Fleming, having rapidly pushed through the earlier stages of the art, and shown his complete mastery over the most massive forgings, quickly caught up with its later development in fashion elsewhere, and produced works by aid of the file, saw, and chisel on the grandest scale. It is small wonder that, when the rôles of smith, clockmaker, and architect were combined in one individual, the more precise, cultivated, and elaborated tools of the mechanician are

brought to bear. In this work there is always a strong leaning to architectural forms, and the effects of wood and stone are produced in iron in miniature. Though it never quite attained the refinement and delicacy of the French, some magnificent work was produced in Brabant, existing examples actually pointing to Louvain, the home of the Matsys, as its principal seat. In the church of St. Pierre, not only the grilles, font-bracket, chandelier and locks partake of this character, but to all the *armoires* of the chapels in the chancel aisles are fitted most exquisite little circular guichets filled with flamboyant tracery of a great variety of design. There is nothing, on the other hand, to indicate its production in Antwerp or Flanders. Had it been produced in any of those vast commercial towns of the Middle Ages, we should doubtless now find it more widely scattered over Europe. As it is, we have only isolated pieces of ironwork of Brabançon character in England, Germany, and Spain. The most familiar objects in collections are, perhaps, the rather flat boxes of moderate size, of small and intricate geometric tracery repeated over the cover and sides, often in longitudinal bands separated by plain ridges and binding. These have peculiar locks, with uniformly rude and ill-designed buttress-shaped hasp and decoration; this identity rendering it probable that they were produced in one centre and abundantly exported.

Of English work of the fifteenth century, one of the best of the "joiner's" grilles closes the Chantry of Henry V. in Westminster Abbey, and was made by Roger Johnson of London, between 1425 and 1431 (Plate 55), the agreement being still extant.* It exactly resembles some of the fourteenth-century joinery, such as that of St. Pierre, at Caen, from which it is perhaps borrowed, since all the details, including the massive timber framing, are reproduced in iron

* A reproduction in wrought iron of a portion is in the Victoria and Albert Museum, no. 1888-426.

by a combination of smiths' work with the use of pierced sheet iron. The design of the doors consists of two tiers of long narrow round-headed arches, filled with a quatrefoil diaper. Behind the arched pieces, which are applied on the face to hide the construction, are heavy vertical bars. The diaper is formed of short and nearly uniform pieces of forged iron, halved where they intersect, and merely wedged into notches prepared in the concealed upright framing. Richness was obtained by duplicating these pieces in sheet iron, cut a little broader, and riveted to the back. The filling in of the arch over the gates presents the earliest example in England of a purely architectural design worked in iron, being filled with tracery, constructed and put together like the diapered work below. The diapered portion of this grille, like most others in England, has its counterpart in France, at Le Puy-en-Velay.

Incomparably the finest work in iron of this class stands to the left of the altar in St. George's Chapel, Windsor (Plate 56). It formerly stood in front of the tomb of Edward IV., and consists of a pair of gates and gate-piers, taking the place of a grille, and only meant to be viewed from the front. Sandford gives an engraving of it in its original place, and says the king lies under a monument of steel, polished and gilt, representing a pair of gates between two towers, all curious workmanship, in the north arch near the High Altar. Tradition has connected it with Quentin Matsys, and in view of Edward's connection by marriage with the Duke of Burgundy, and the vast trading transactions with the Netherlands, this suggestion did not seem unreasonable. But documentary evidence proves that it was the work of an Englishman, Master John Tresilian, who was at the time (1482-83) principal smith of St. George's Chapel. It no doubt formed an important part of the monument, and is the most magnificent and unrivalled specimen of its kind in existence. The design is in the richest

style of fifteenth-century architecture, recalling in its general lines the stone chantry of Henry V., then painted and gilt, in Westminster Abbey. The ironwork is worked out in full relief and in the minutest details, and consists of two gates about seven feet high, and two much higher hexagonal piers. The gates are formed each of three bays, separated by buttresses with richly crocketed niches and finials. The bays are formed of a traceried window in two stories, surmounted by a three-sided canopy, equally in two stories, the arches filled with extremely delicate vesica and perpendicular tracery and crocketed pinnacles and finishing in a parapet of open vesica pattern. The upper story of the canopy recedes, and is connected by flying buttresses with the lower, the spaces filled with most delicate tracery, with open-work trefoil cresting, and every kind of purely architectural enrichment known to the period. The piers are an exact repetition in their lower story of the bays of the gate, but arranged in plan as four sides of a hexagon, so that there are double buttresses at each angle; the additional upper story is formed of double-light traceried windows, overhung by very rich canopies of one story, almost repeating the lower tier, but with the angle buttresses continued up, and bearing five richly wrought open cressets or lanterns forming a strikingly effective and original finish. This great amount of repetition is common in Perpendicular work. Many thousand pieces of carefully filed iron have been required in the construction of this monumental work; and the caps, bases, mouldings, crockets, and cusps are chased out of the solid, and tenoned, morticed, and riveted together as in joinery, but in small pieces, held together by cotter pins at the back. The whole can thus be taken to pieces and packed in baskets, as observed by Miss Fiennes in her diary more than two hundred years ago. This method of construction facilitated the transport of so large an object, but is otherwise almost unknown in ironwork. Depth and

richness are given by using one thickness upon another over a background of saw-pierced sheet iron, and the intricacy of detail produced by this process becomes most remarkable in an object of such dimensions. The whole was originally gilt, and remained in this state when it was described by Gough, the antiquary, as a work of gilded copper. On the south door of the ambulatory is a "vizzying," or guichet, a square escutcheon, and a handle-plate in form of a rose window surrounded by the Garter, all worked in the same way in tracery of marvellous minuteness. The chapel also boasts two other fine flamboyant locks. All these must be from the hand of Tresilian. Locks, handles, and "vizzyings," of elaborate flamboyant tracery, are not unknown in other places in England. A most beautiful specimen of the latter is preserved at Compton Wynyates, brought from the older house dating from the last years of the reign of Henry VII. ; while another most interesting specimen, introducing the wattle border, is in the Victoria and Albert Museum. (Plate 57.)

The lock from Beddington House, Surrey, now in the Victoria and Albert Museum (Plate 58), shows that this style of work survived until the early years of the sixteenth century. This wonderful piece of wrought and gilt iron has in the lower central panel the Royal Arms and supporters used by Henry VII. and Henry VIII., flanked on each side by two upright panels of openwork tracery with a twisted column between, the whole enclosed in a roped moulding. It measures no less than $13\frac{5}{8}$ inches in length by $8\frac{7}{8}$ inches in height. Much has been conjectured as to its original use, but all that can be stated with certainty is that it came from Beddington House, the manor house of the Carews of Beddington, where it had been for a very long period.

A rich example of work in Flemish style may be seen in the gates closing Bishop West's Chapel in Ely Cathedral, made in 1515. A detailed description would require space ; but it is

sufficient to say that the design forms an upper tier of linear panels of twisted bars, with forged caps and bases, and very richly traceried arches; and a more severe lower tier of narrower panels, with a base of pierced tracery, a band of very Flemish arabesque work, and a top of very beautiful traceried arches, including fleurs-de-lis and shields. Above all this panel-work are some heavy branching interlaced scrolls filling in the arch, and recalling the work of the Antwerp well-cover, except that they blossom into Tudor roses instead of leaves. A touch of Flemish Renaissance feeling is given by the massive turned and moulded slam-bar.

Belgian work of this date is to be found abundantly in the towns between the Meuse and the Rhine, once forming the Duchy of Cleves, and as far south as Cologne. The magnificent candelabrum and bier-stand at Xanten, the candlestick at Neuss, the dwarf grille at Kempen, the grille at Calcar, the fine bracket at Zülpich, the hinges from Viersen, are known examples, and there are hosts of others. These are distinct from German work, though the Germans were quite ready to assimilate the style as far as they could. Thus the traceried work they produced was as elaborate as the Brabançon, if not more so. A singularly rich and beautiful tabernacle grille in the Victoria and Albert Museum, notwithstanding its unusual elaboration, shows clearly that the German productions were as inferior to the Flemish as these were in turn to the French. In this specimen, which is here illustrated (Plate 59)—said to have come from the château of Ottoburg, in the Tyrol—it will be seen that, while the tracery is delicate, the buttresses and pinnacles are coarse. German imitations of this purely architectural kind of ironwork are not very interesting.

Traceried grilles are to be found in the Church of St. Ulric in Augsburg, one of which, supposed to date from about 1470, consists of a vesica-shaped diaper, filled with tracery, in which the fleur-de-lis is an oft-repeated ornament. Tracery ornament

was used for screens at Heidingsfeld, near Würzburg, 1510, and more frequently for tabernacle doors. At Lüneburg are beautiful strap-hinges crossing a door, and richly worked handles, of delicate and finely coloured tracery design. Intricate open tracery handles are peculiarly German, as are the tracery back-plates, and their intertwining, leafless, and branching handles. No grander specimen has been produced than a lock-plate eighteen inches high, taken from the Church of Maria-Saal, in Carinthia, now preserved in the Klagenfurt Museum. From its unusual size and elaborate character it is regarded as having been a diploma work. In Plate 60 we find similar workmanship applied to a clock.

It is only, however, when traceried designs begin to develop into something else that they become of interest. At Cologne, celebrated as a cradle of art, and with so much in common with, and united by such close ties to, the trading cities of Flanders, the Brabançon ironwork roused a strong spirit of emulation. Thus it is at Cologne that we meet with one of those massive forged iron cranes for raising the font-cover, which are otherwise wholly peculiar to Belgium. Its simple triangular form filled with feeble vesica tracery, and its unnecessary and defective mechanism, proclaim it the effort of a 'prentice hand. Then we have, diverging more and more from the Flemish style, the curious *rastellum*, a light traceried railing with fleur-de-lis cresting, and five prickets for candles and five shields emblazoned with tailors' shears. This is supported on a rafter most exquisitely painted with figure-subjects after the Cologne School, while the ironwork is rose and blue and gold. In the same traceried character is the bell-holder of St. Cunibert's, the lantern and bracket at the Rathhaus, the bracket at Plückhof, the grille at Gross St. Martin's, and the trellis grille in the Dom surmounted by a cresting like that of the *rastellum*, but more imposing. These suffice to show how well the Flemish style of ironwork was

received and incorporated at Cologne, whence, as from an advanced post, it penetrated to the heart of Germany. As a specimen of work from Flanders, or due to Flemish inspiration, we have cited the celebrated herse-light of Osnabrück, a large triangle filled with rose-window tracery, holding fifteen prickets on its upper margins, supported on a tripod foot, and embellished with tracery, shields, and fleurs-de-lis. The magnificent *Chapelle ardente* of Nonnburg, near Salzburg, restored from existing fragments, and engraved by Gailhabaud, is another grand specimen of ironwork of architectural design. It consisted of roof or catafalque with six gables, supported on twisted columns, filled with tracery and cusps, holding innumerable prickets along its ridges and eaves, and adorned with numerous finial-like candelabra at its angles. Beneath is a dwarf railing filled with tracery, also supporting candelabra. Among other remarkable specimens are the pulpit and candelabra of Oberdiebach, near Fürstenburg. Nor should we omit, among the many important German works, the magnificent corona made by Gert Bulsinck of Vreden in 1489, and presented to the church by the Corporation of Locksmiths. It consists of two most richly pierced sheet-iron bands, to which are attached canopied niches with figures of saints, and in front of each a candle. In the centre, beneath a wrought canopy, is a figure of the Virgin in gilded wood, and above are two kneeling figures.

The Cologne smiths did not confine themselves to reproductions of the traceried work, but were still more bent on acquiring the particular style, characterised by its mixture of tracery and beaten leafwork, of which the Antwerp well-cover is so famous an example. The Cologne ironwork of the sixteenth century is distinguished from that which preceded it in Germany and elsewhere by the constant use of the thistle, a plant only used rarely with us, as in the choir gate-hinges at Wells. Perhaps the richly cut and wrapped vine or acanthus

leaves of the Louvain crane and the Antwerp well-cover suggested thistles, or perhaps the fine form of the plant and its religious associations led to its spontaneous selection. At all events, not only the glossy foliage, but the flowers and buds of the holy milk-thistle lend themselves to an extremely rich, and at the same time conventional treatment, while the legend that the white veins on its leaves were caused by the falling on it of a drop of the Virgin Mary's milk would be likely to render it at that date extremely popular in Germany. The flowers, buds, and leaves of the plant begin to appear among the traceried iron from the beginning of the sixteenth century, and spread thenceforward over Germany as rapidly as the plant itself is propagated over pastures new by its airy thistle-down. It immediately ousted the vine, and as effectually as its original has ousted the indigenous plants of countries cursed by its introduction; and for a century no ironwork of any pretension was forged in Germany into the composition of which the thistle did not enter. In the funeral candlesticks from St. Columba's Church, Cologne, and the beautiful wall-brackets of the Rathhaus *Freitagsrentkammer*, probably made in 1549, we see its boldly modelled leaves as well as a band with towers and buttresses at the angles enclosing the prickets. A still finer example is figured by Raschdorff, from a private collection in Cologne.

When treated flat, as in pierced sheet-work, of which great use was made, the ornament is arabesqued and rendered very rich. Most exquisite specimens of this work are the two coronæ in Magdeburg cathedral. These consist of a wide band of richly pierced design, with battlemented top, suspended from a crown by several curved and decorated rods, to which are attached brackets holding prickets for candles. The chandelier in the church at Kempen is another magnificent example, in which the whole ornament is derived from the thistle, except the figure of the Virgin, the leaves

having in this instance taken a definite cruciform shape, which henceforth characterises them until the final disuse of the plant in ironwork. Another example presents us with the image of the Virgin, with six richly scrolled iron arms for prickets, all fashioned from this plant. The thistle formed the basis of much of the pierced and slightly embossed sheet-iron, sea-weed-looking ornament, applied to locks, hinges, and handles, in which the iron was brightly tinned and laid over red cloth or paper. The splayed locks peculiar to Germany were often treated thus, as in the Rathhaus of Cologne, and that of Bingen, and elsewhere on the Rhine. Thousands of examples are to be met with, varying from the utmost simplicity to extreme richness. A small but interesting group, dating from the fifteenth century, may be seen in the Victoria and Albert Museum, of which two fine examples are illustrated (Plate 61). Perhaps the most complete illustrations of the various purposes the ornament was made to serve are to be seen at St. Maria im Capitol, in Cologne, where the reading-desk, door-hinges, locks, and handles are all ornamented with this pattern. The richest examples of this kind seem due to A. F. Butsch, whose work is to be seen in the locks of the chapel at Blumenburg, near Munich. There are also some particularly rich hinges in the Nuremberg Museum, embossed to an unusual height, and assuming, as frequently happens, an almost geometric arrangement. The filling-in of a bracket at Xanten is a magnificent example, in which the scrolled and interlacing thistle is seen in every stage, from the bud to the fully developed flower and fruit.

Sometimes the plant is introduced as a single flower terminating a strap-hinge, as at Hagenau, or the vertical bars of a grille, as in the Cathedral of Freiburg im Breisgau, dated 1538; but more often every part of the design is an adaptation from it. In German hands, the thistle, like its predecessor the vine, became protean, and simulated the oak, the fan, the Eastern

spathe, the fleur-de-lis, the cross, or mere tracery. Even when almost all sense of its original form is lost, the derivation is sometimes betrayed by some cross-hatching, the last trace of the calyx.

Connected in some measure with the thistle was the fashion



FIG. 31.—Part of door in the Priory of Bruck, with pierced and embossed ironwork. 15th century.

of lining entire doors with pierced and embossed plates and straps of iron, already mentioned as occasionally practised in France, and as having been carried to a point of unusual magnificence in Erfurt Cathedral. It was very prevalent in Austria, Bohemia, and Poland. Though many examples are met with in Vienna, they are but little known in this country,

where scarcely any attempt to render the defensive linings of doors a means of decoration has been made since the thirteenth century.

None of the Austrian examples appears to be older than the fifteenth century, and the custom was retained long after the adoption of the Renaissance architecture. They are all characterised by great richness of detail, and when illuminated in black and white, red and blue, and profusely gilded, their effect must have been very splendid. There are several in the Rathhaus and University of Cracow, based on the thistle, by no means the richest of them. They were evidently produced in the latter half of the fifteenth century. A still more beautiful example, perhaps the finest in existence, belongs to the Priory of Bruck, on the Mur (Fig. 31). The door is diapered with banded iron, studded with nails shaped into rosettes, and the interspaces are filled with the most elaborately pierced and embossed ornaments of fine German late Gothic character. The thistle and fleur-de-lis are twined into arabesques, or mingled with tracery of extraordinary diversity and beauty, few of the designs being repeated. The ground of the lozenges was painted alternately red and blue, so that the general effect was like gold lace on a scarlet-and-blue chequer. The more usual plan, however, not only in secular but in ecclesiastical buildings, was to fill the interspaces with armorial bearings oft repeated. These were sometimes merely painted on the woodwork between the iron straps, as in the example from the Castle of Karlstein, near Prague, in which the black eagle of Austria on gold alternates with the silver lion of Bohemia on red. The iron straps are fixed by well-modelled nails and decorated with gold-and-black rosettes. The beautiful door from the suppressed monastery at Krems has, on the other hand, the armorial bearings splendidly embossed in iron. The upper half of the door bears griffins alternating with a coat of arms, and the

lower half is diapered with imperial eagles and lions. The nails are finely worked. Doors of the same workmanship exist in Carinthia and the town of Steier, all believed to date from towards the close of the fifteenth century. The type may be seen in an example in the Victoria and Albert Museum (Plate 62) in which the lozenge-shaped panels are embossed with eagles displayed, lions rampant, and the arms of Nuremberg, at which city it was originally acquired. The dividing straps are set with boldly designed nail-heads, and the door is furnished with a guichet of trellis-work and a handle.

These diapered designs appear to have been suggested by the trellised grilles of the tabernacle doors of Belgium and Germany, which the richer taste of further east decorated with rosettes and other ornaments at the intersections of the bars, as seen in two fine examples in the Museum. The main bars were always massive, though often almost wholly concealed by pierced foliage and arabesques; and the interstices, which in the richer examples were rectangular, are filled with carved iron tracery, with filigree, or with pierced and embossed subjects. Plate 63 shows one of the doors of a tabernacle in the Hospital Church at Krems; the designs filling the interspaces are cut out of sheet metal, embossed and chased, and represent Biblical and other scenes. Three similar doors in the church at Znaim still preserve their gold and coloured decoration. Other beautiful examples exist in Vienna, Mödling, Pressburg, and in Styria and elsewhere, on which a great amount of work has been expended and which well merit careful study.

This trellis is as distinctive of German smithing as the thistle, and was evidently first borrowed by Belgium from the sparse and much older examples of England and France. In the oldest specimens in Germany, such as those of Cologne and Aix-la-Chapelle, all the diagonal bars passing in one direction are threaded through those passing in the opposite

way ; but in the somewhat later and more ponderous example of Magdeburg, 1495, they pass through each other alternately, as in the familiar work of a century later, from which they differ, however, in being made with square instead of round iron. It seems as if the German smiths were already courting difficulties in order to display their skill. These grilles are complicated by rings and other ornaments interlaced in the bars, and are associated with richly traceried cornices, twisted and moulded vertical bars, armorial bearings, etc.

Bound up with the development of the trellis grille was that of the Passion-flower. A richer form than the thistle was needed for the termination of the standard bars and the intricate crestings associated with them. This seems to have been supplied by elaborating the ordinary twelfth-century iris or fleur-de-lis, which consisted of two inner elevated, and two outer recurved petals, and two stamens. Like all other forms that passed into the hands of German smiths, this became rapidly complicated, until the result bears a somewhat strong resemblance to the Passion-flower. The mystic sentiment associated with the *Flos passionis* from its earliest discovery would appeal strongly to so imaginative a people, and the form of flower soon became a favourite. Its interest was due to a fancied resemblance of its flower to the implements of the Passion. Thus its corona was the crown of thorns, its stamens the nails or wounds, and its petals and sepals symbolised ten of the apostles. The effect of fervid imagination is seen in the illustrations of the flower in contemporary botanical works. The fully developed type in ironwork belongs, however, to the Renaissance, and consists of a spindle-shaped coil of wire for the pistil, with elongated hammer-shaped stamens, and slender recurved petals. We shall meet with it again in our second volume.

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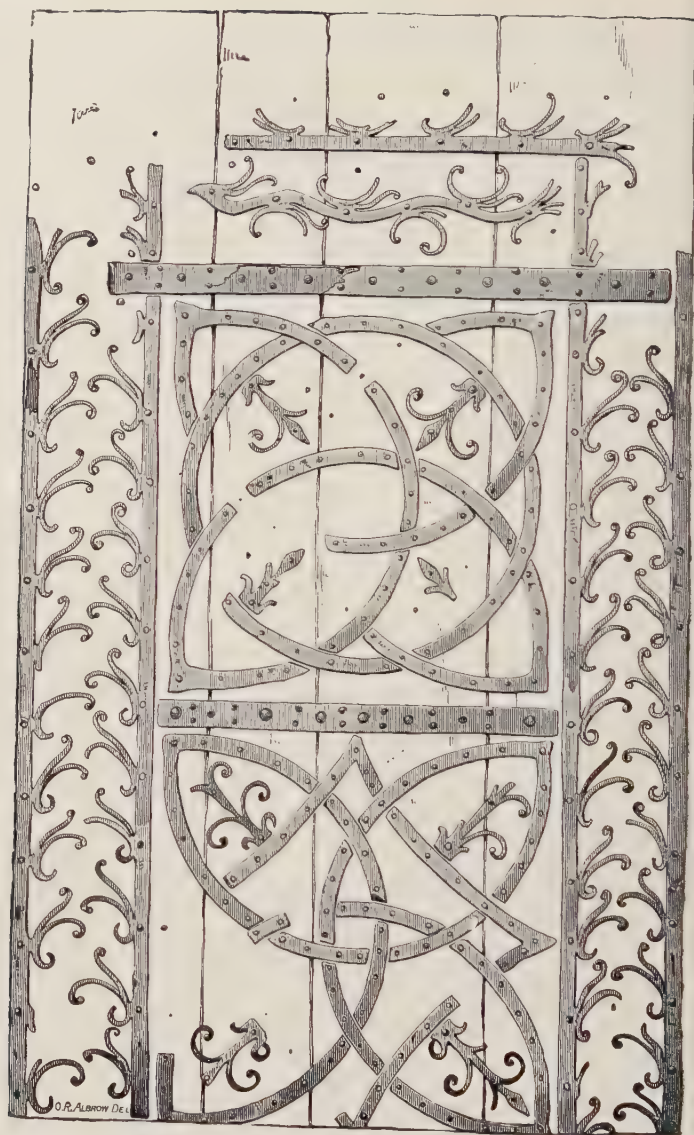
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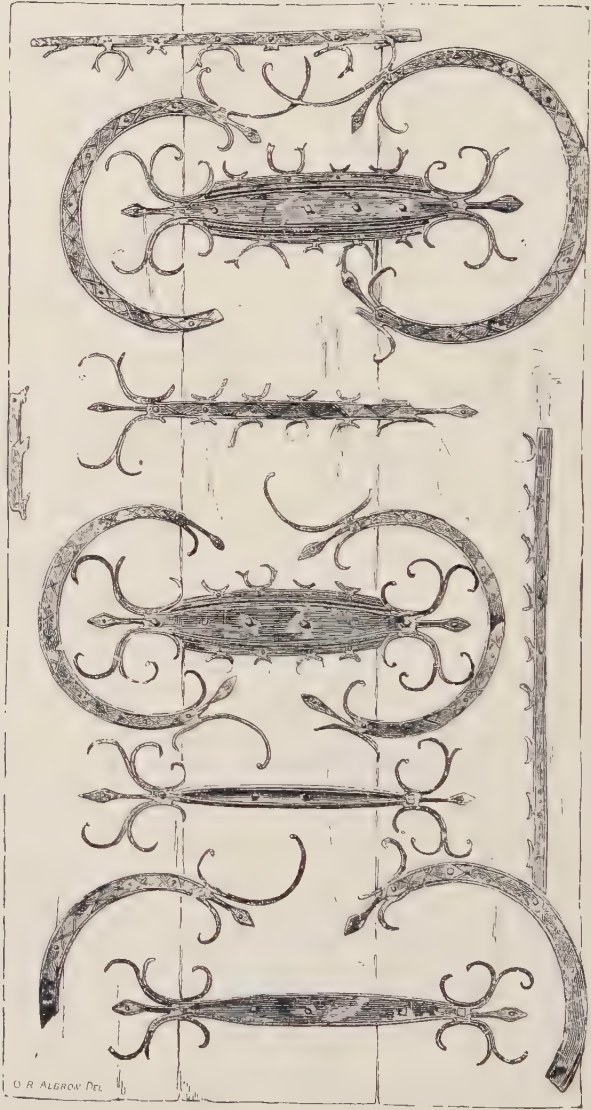
Door at Stillingfleet Church, Yorkshire. About 1145. (p. 59)



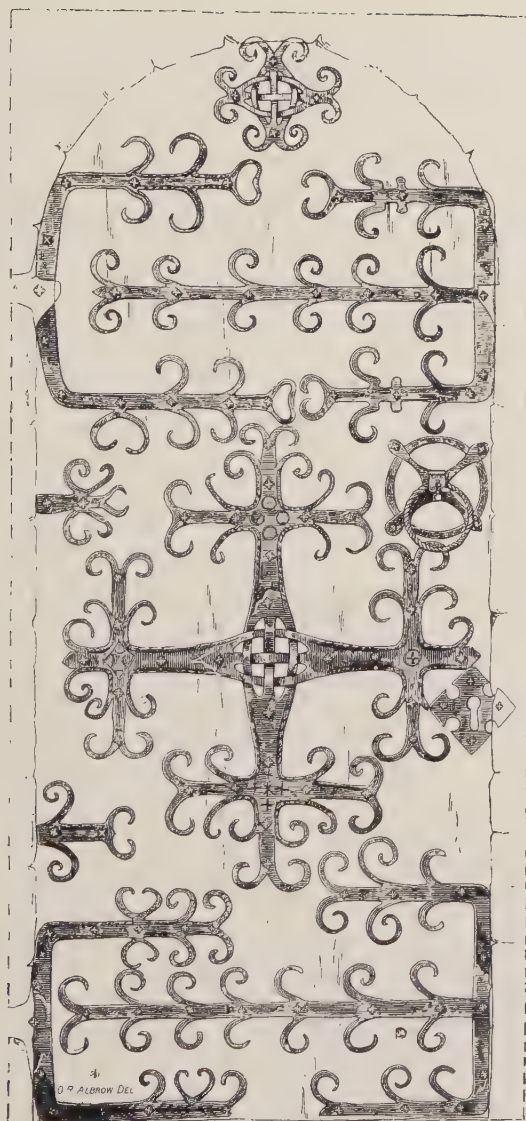
Disused door at Much Hormead Church, Hertfordshire.
12th century. (p. 60)



Church door at Willingale Spain, near Ongar, Essex.
12th century. (p. 61)



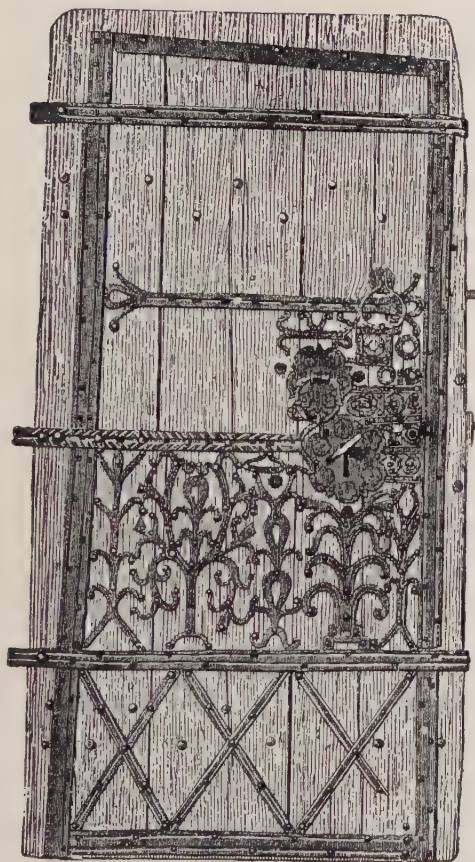
Ironwork at Eastwood Church, near Rochford, Essex.
12th century. (p. 62)



Hinges, etc., at Haddiscoe Church, Norfolk.
12th century. (p. 62)



Strapwork from the Slype Door of St. Albans Abbey.
12th century. In the Victoria and Albert Museum,
no. 356-1889. (p. 63)



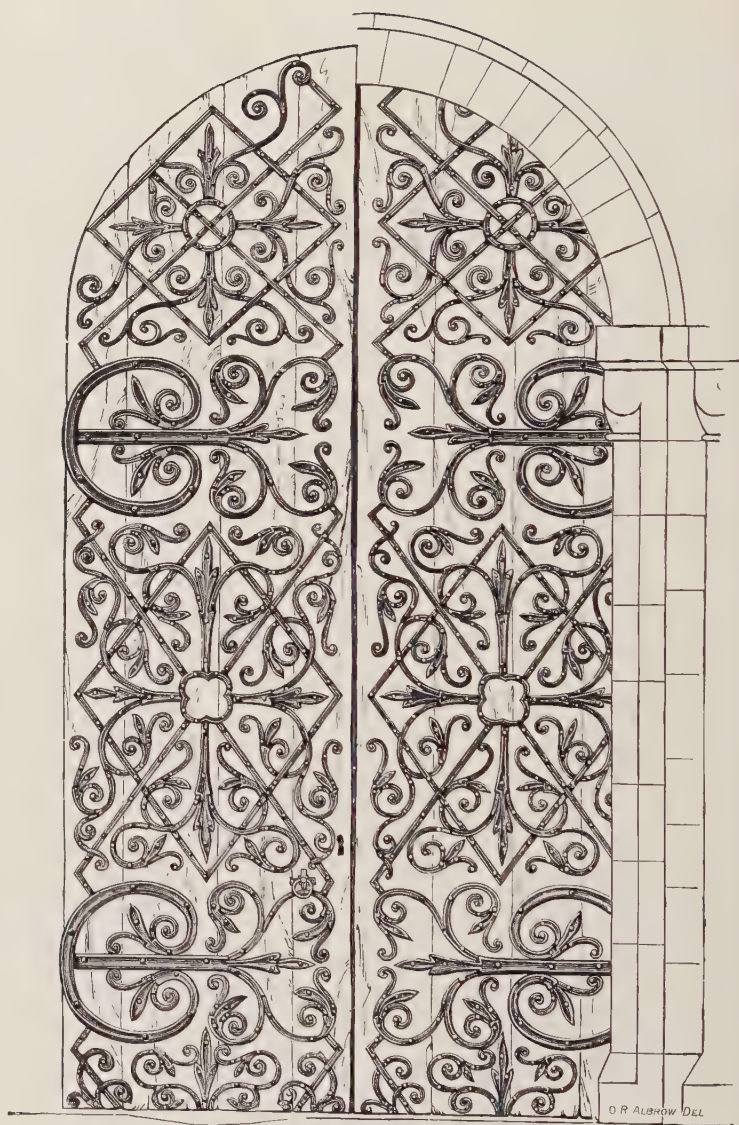
Ironwork on a door from Vänga Church.
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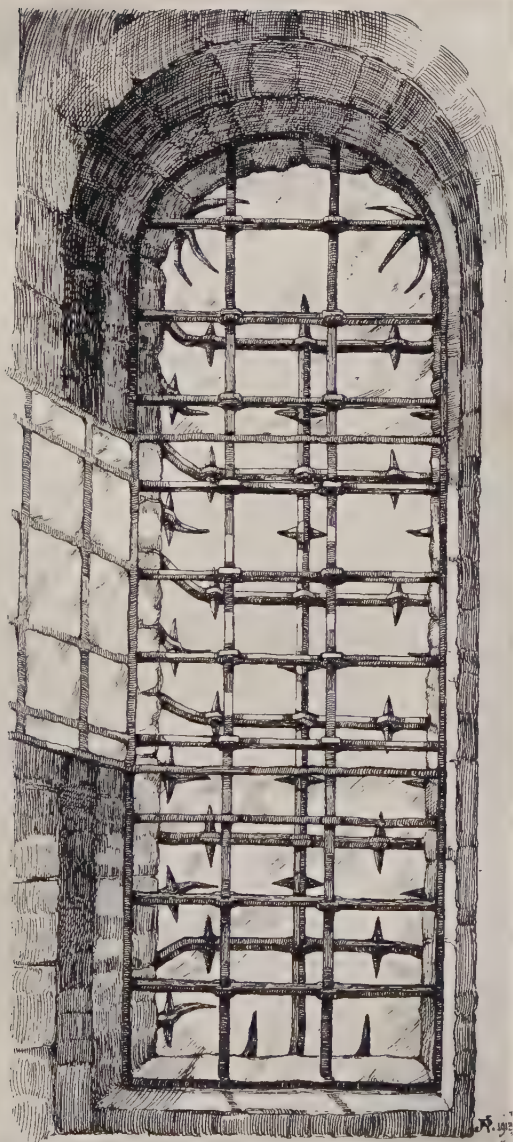
Door of Faaberg Church, Sweden.
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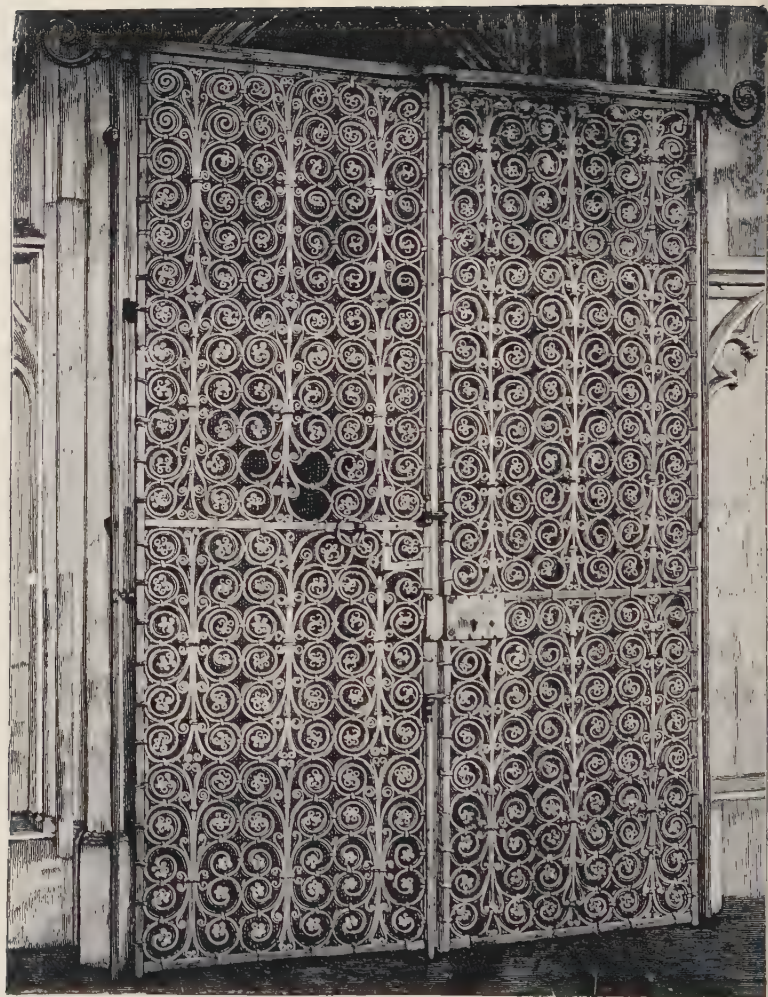
Door from Gannat, Auvergne. About 1200. In the Victoria and Albert Museum, no. M. 396-1924. (p. 68)



Ironwork on north aisle door of Durham Cathedral.
French ; about 1135. (p. 68)



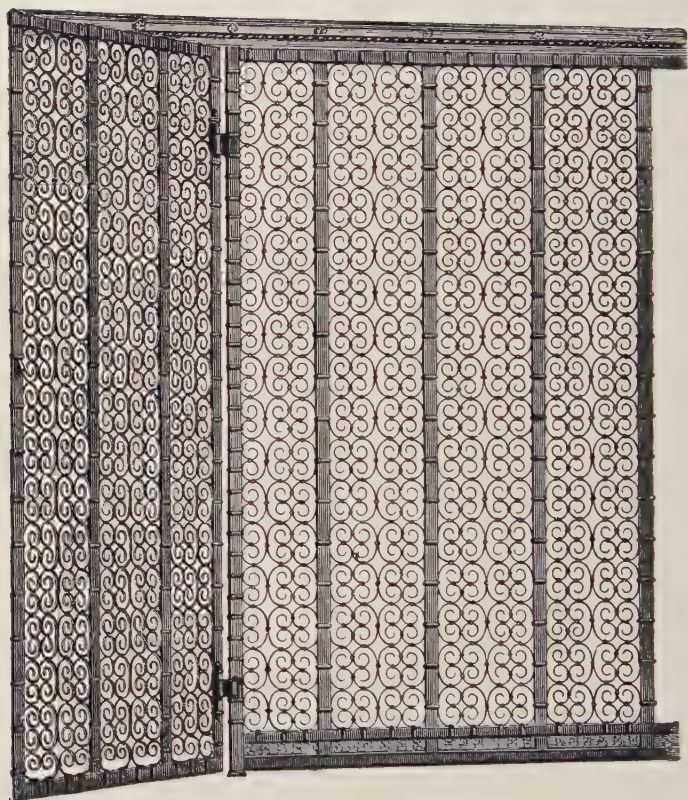
Treasury window-grille, Canterbury Cathedral.
13th century. (p. 70)



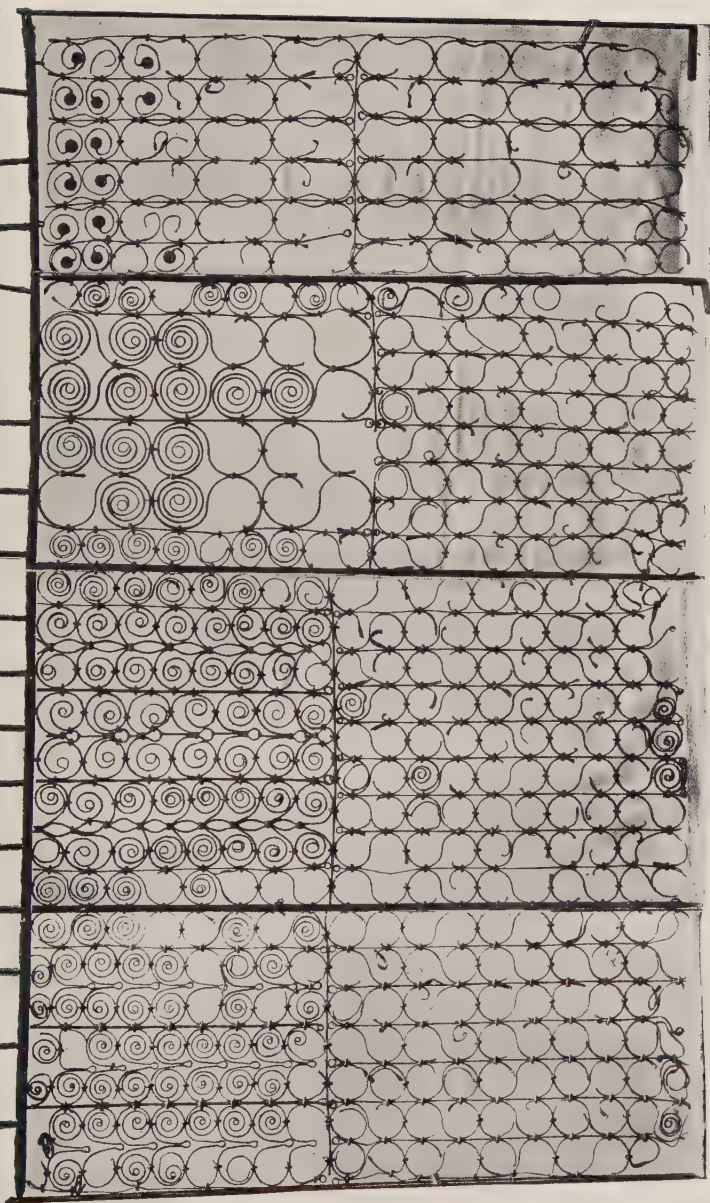
The St. Swithin grille in Winchester Cathedral (1093). (p. 72)



Part of a panel said to be from the Abbey of Ourscamp, Picardy (1201).
In the Musée Le Secq des Tournelles, Rouen. (p. 73)



Part of the choir grille in Lincoln Cathedral. (p. 73)



Grille from Chichester Cathedral. English; 13th century. Victoria and Albert Museum, no. 591-1896. (p. 74)



Entrance door at Worksop Priory, near Nottingham.
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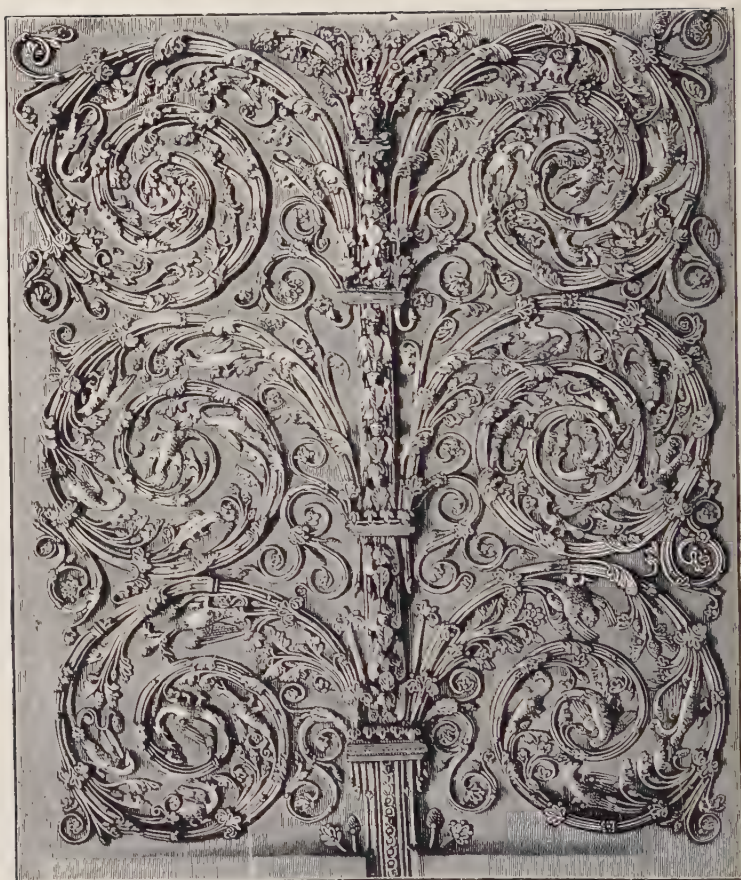
Door at Sempringham Church, Lincolnshire. 13th century.
(p. 77)



Door at Market Deeping Church, Lincolnshire.
Early 13th century. (p. 77)



Oak coffer, decorated with wrought-iron scrollwork. French; second half of 13th century.
In the Victoria and Albert Museum, no. 733-1895. (p. 79)

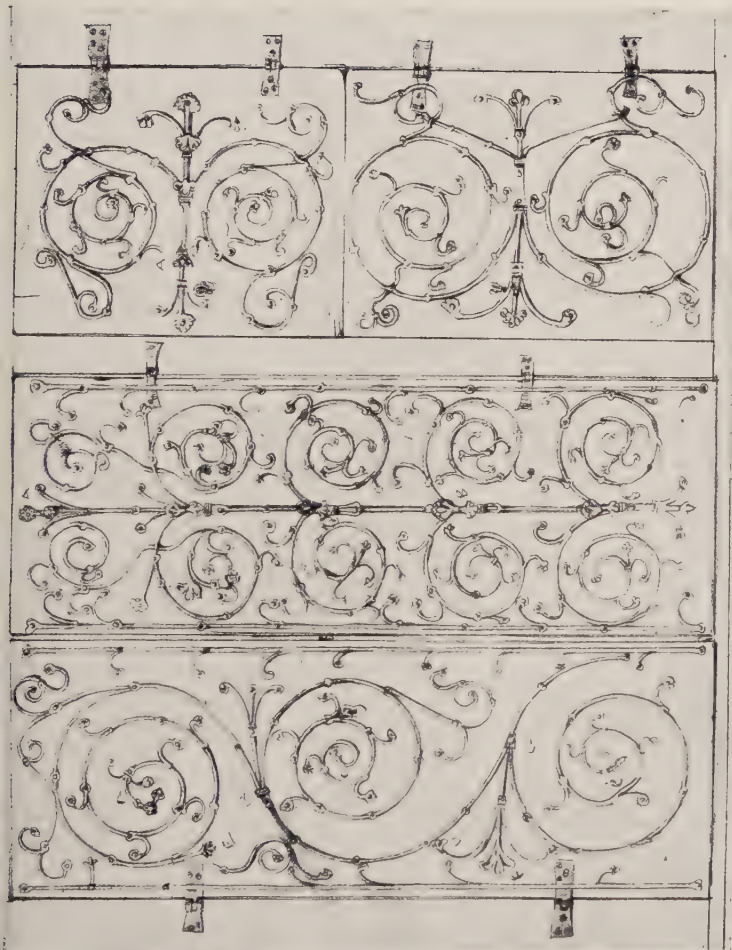




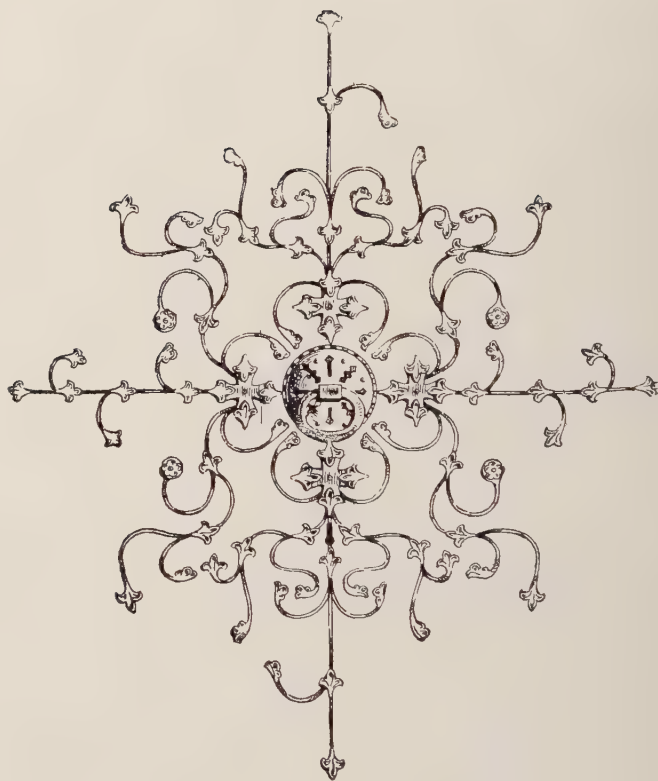
Press in the Church of St. Jacques at Liège. (p. 81)



Door at St. George's Chapel, Windsor.
Middle of 13th century. (p. 82)



Aumbry doors at Chester Cathedral. (p. 82)



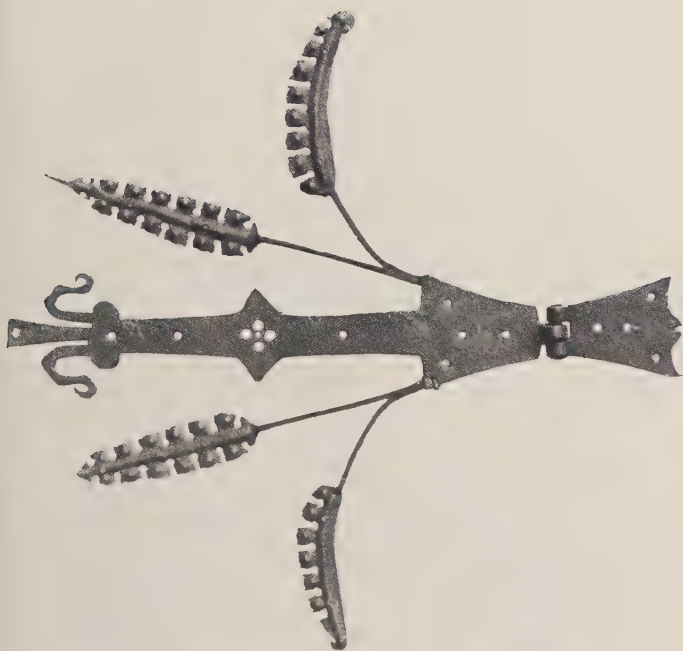
Handle-plate on door at Tunstall.
End of 13th century. (p. 83)



The Eleanor grille or herse, in Westminster Abbey. English. Made by Thomas de Leghtone in 1294. (p. 83)



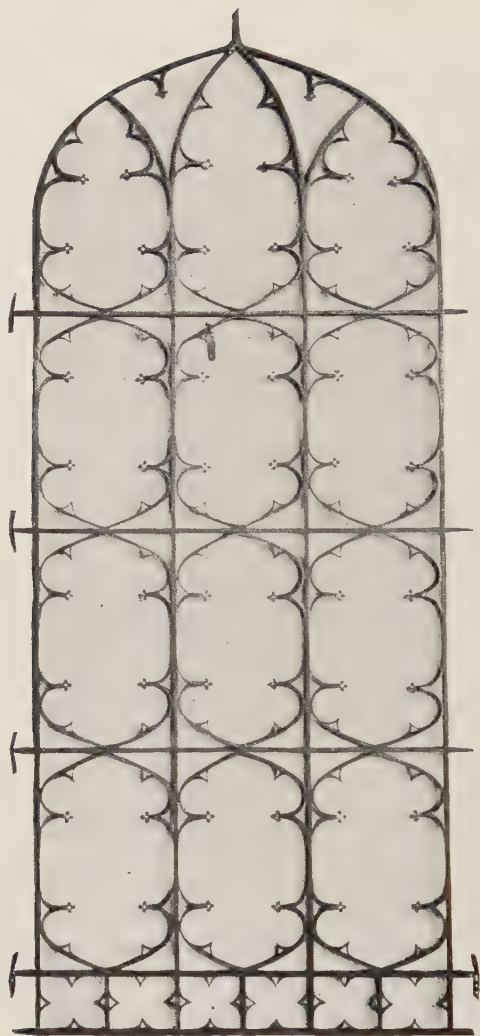
Door of tabernacle, St. Sebald's, Nuremberg, about 1320-50. (p. 89)



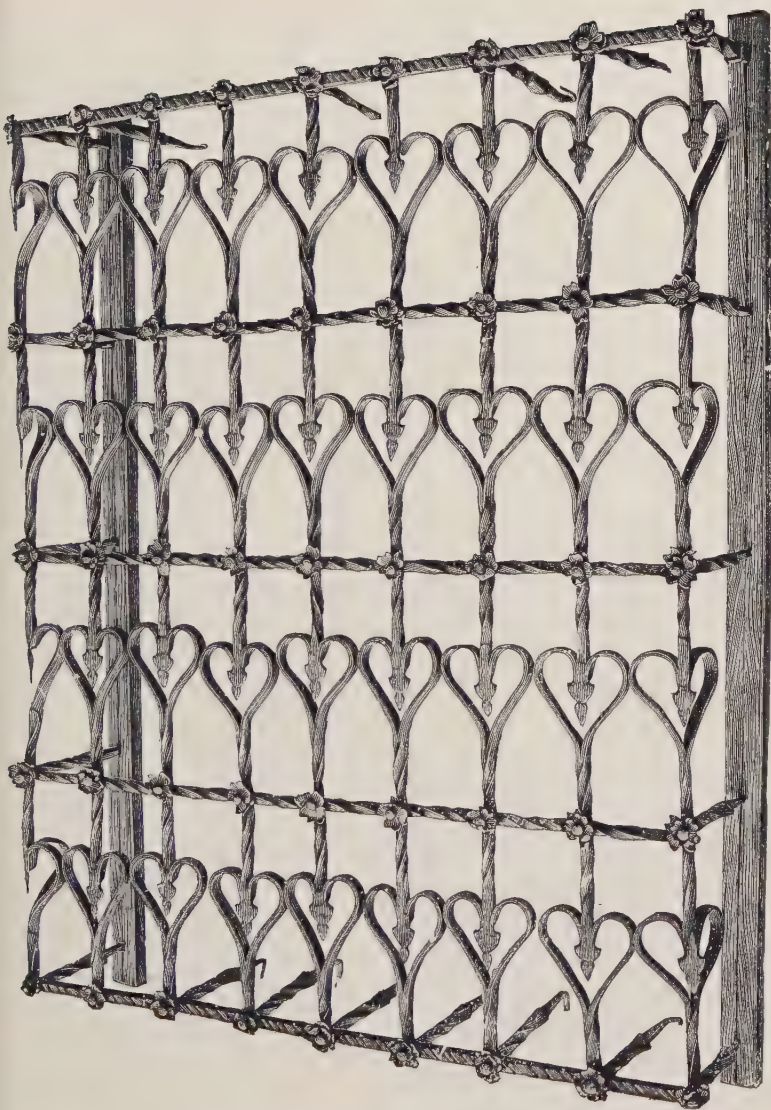
Vine-pattern hinge. French; 15th century. In the
Victoria and Albert Museum, no. 670-1895. (p. 89)



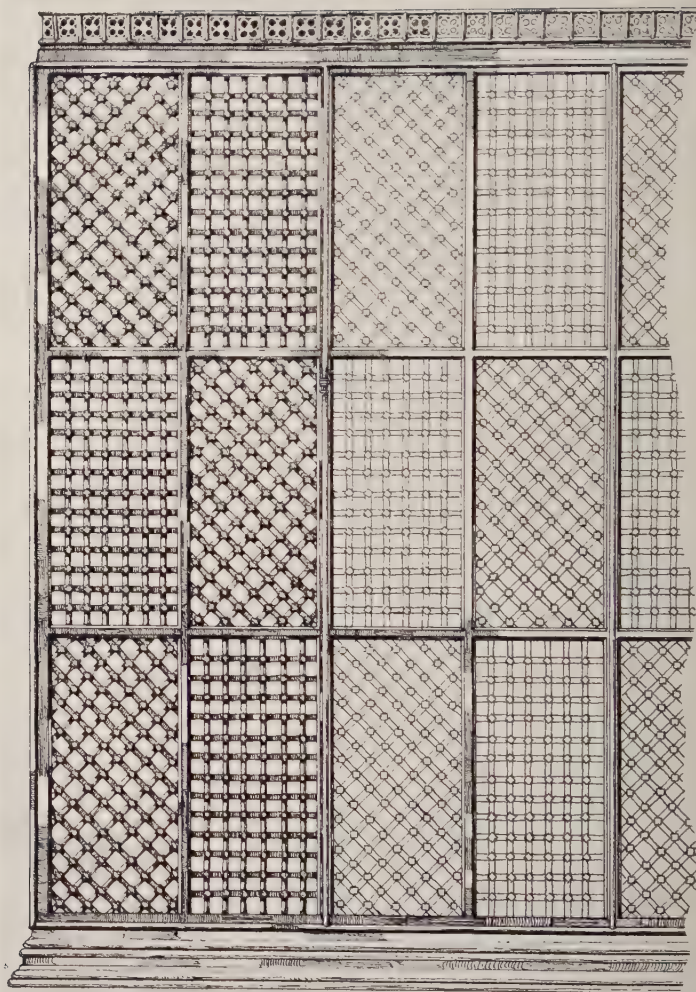
Vine-pattern hinge. French; 13th century. In the
Victoria and Albert Museum, no. 493-1895. (p. 79)



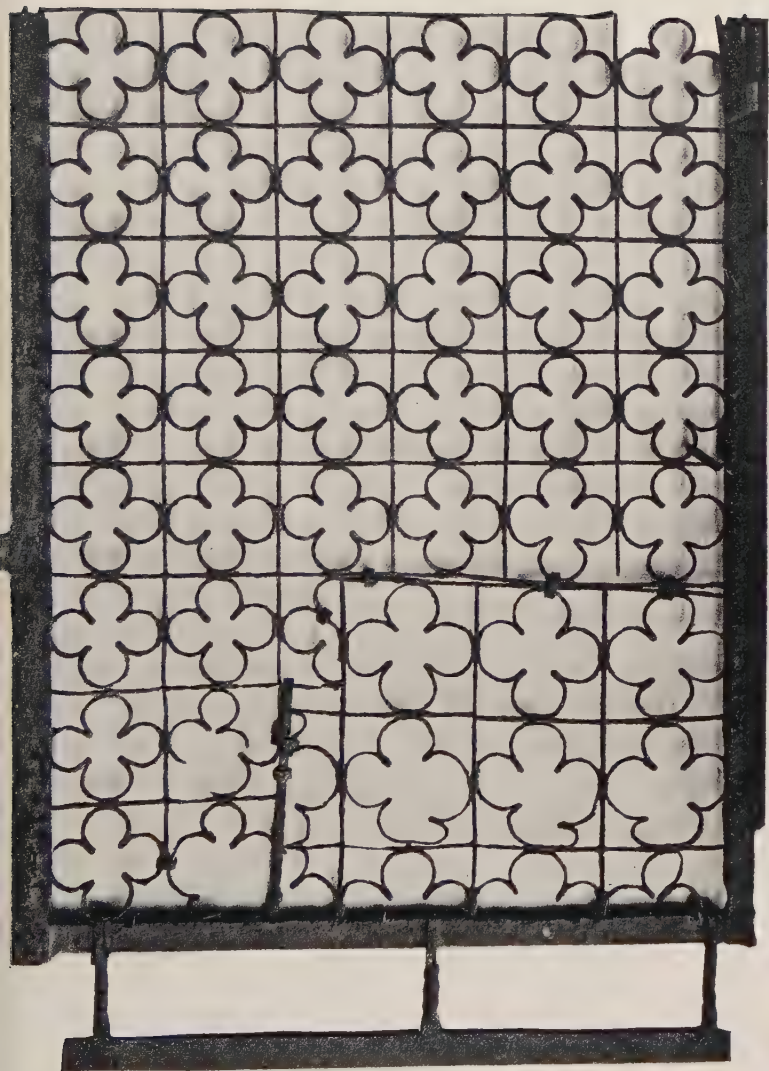
Window grille of tracery design. Italian ;
15th century. In the Victoria and Albert
Museum, no. 741-1893. (p. 98)



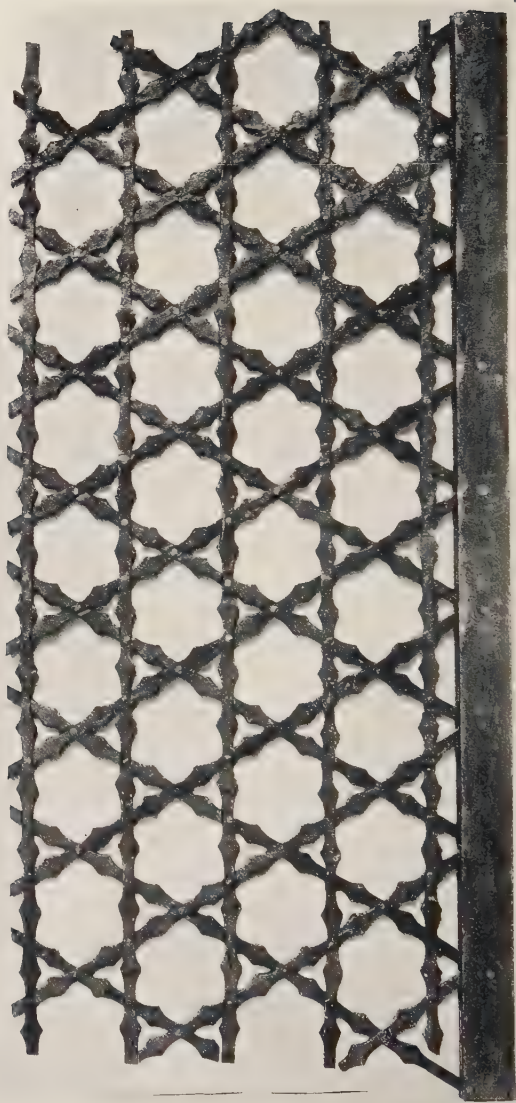
Grille from the house of Jacques Cœur, Bourges ; 15th century.
In the Musée Le Secq des Tournelles, Rouen. (p. 100)



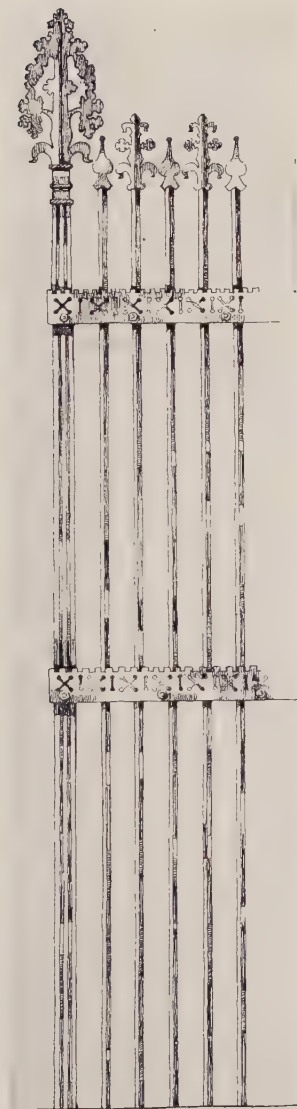
Grille at St. Albans Abbey. Middle of 15th century. (p. 101)



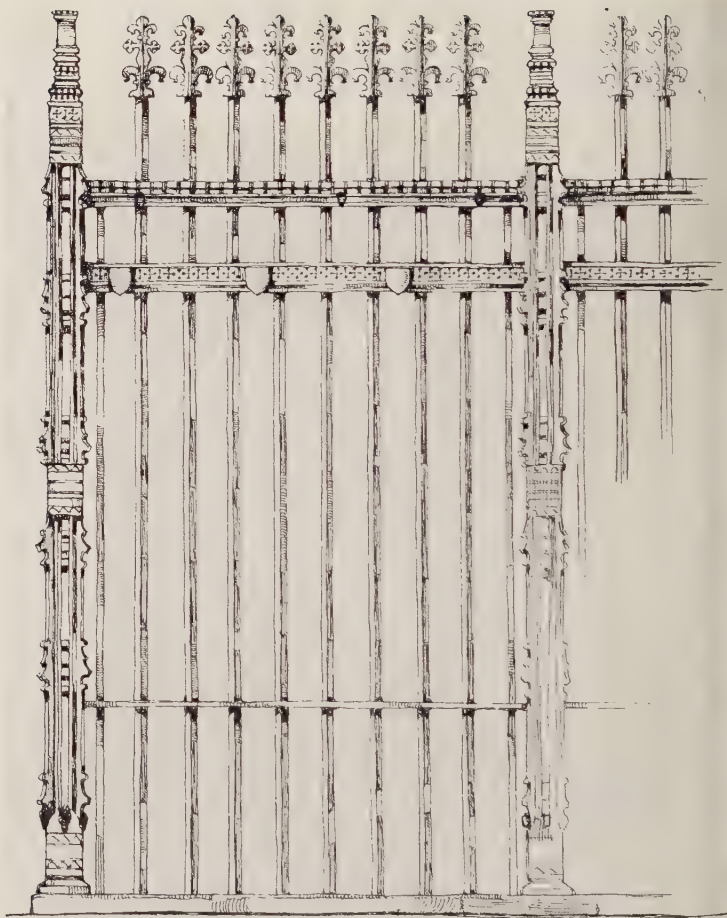
Part of a pair of gates from Chichester Cathedral. English; second half of 15th century. In the Victoria and Albert Museum, no. 592-1896. (p. 101)



Part of choir gate at Canterbury Cathedral. Beginning of 14th century. From a reproduction in the Victoria and Albert Museum, no. M. 1912-2. (p. 102)



Rail to the tomb of Sir Thomas Hungerford
at Farleigh, Somerset. About 1465-1470.
(p. 105)



Rail to the tomb of Bishop Beckington at Wells Cathedral. About 1465.
(p. 105)



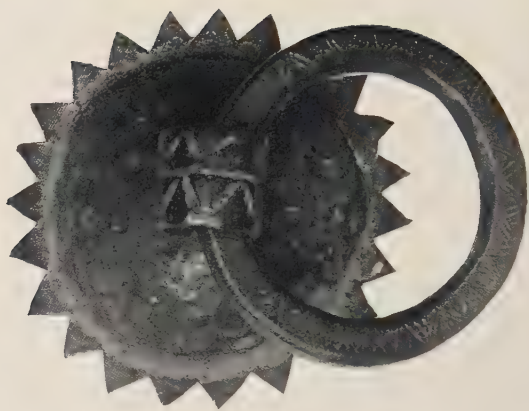
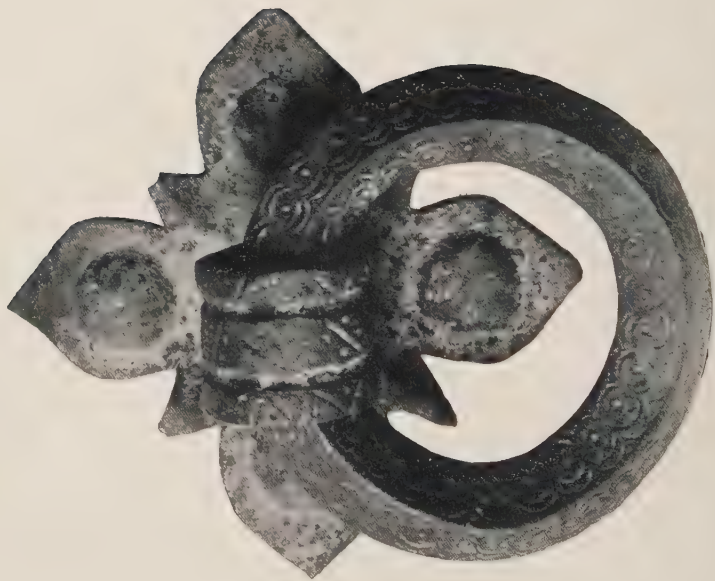
Screen in Arundel Church, Sussex. Early 15th century.
 From a reproduction in the Victoria and Albert Museum,
 no. M. 1911-8. (p. 105)



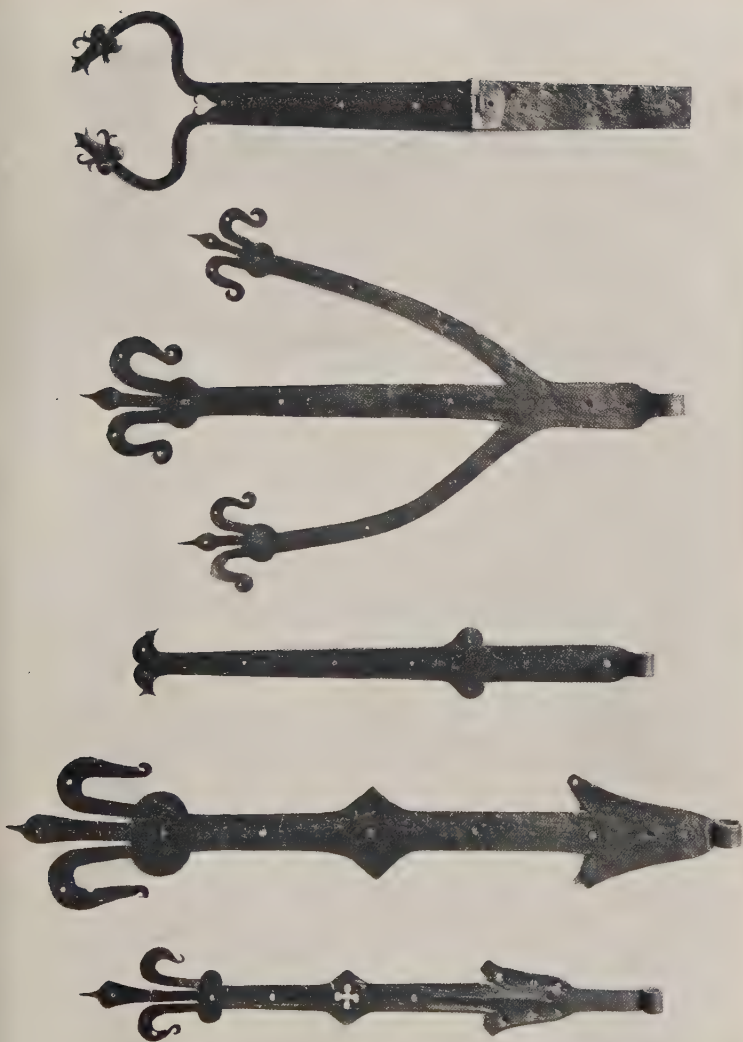
Tomb-railing (herse), from Snarford Church, Lincolnshire. 15th century
In the Victoria and Albert Museum, no. 47-1867. (p. 105)



Door-handle on the Garstang Chantry, Cirencester Church (15th century).
(p. 107)



Door-handles of Oriental design. Spanish ; 16th century. In the Victoria and Albert Museum,



Hinge-bands. German, about 1500. In the Victoria and Albert Museum, nos. 895 to 898-1907. (p. 110)



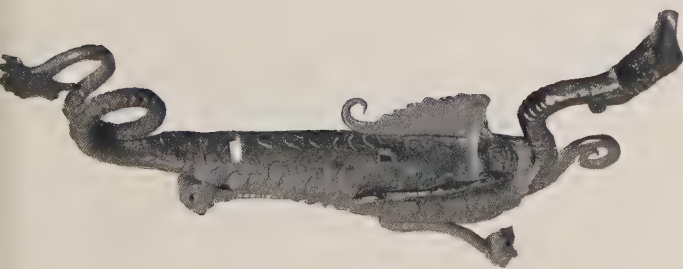
Door of an aumbry. French; late 15th century. In the Victoria and Albert Museum, no. 569-1899. (The figure and shield of arms are in bronze.) (p. 113)



Lock. French 15th century. In the Victoria and Albert Museum, no. M. 636-1910. (p. 114)



Locks. French; 15th century. In the Victoria and Albert Museum, nos. M. 635, 637-1910. (p. 114)



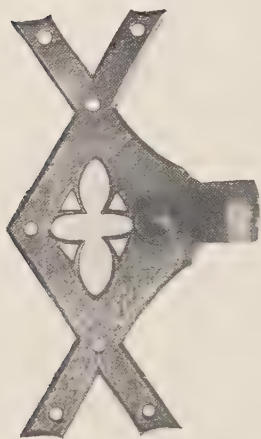
Door-knocker. German ; late 15th century. In the Victoria and Albert Museum, no. 960-1893. (p. 116)



Pierced hinges made from rolled sheet iron. German ; 16th century. In the Victoria and Albert Museum, nos. 867, 862-1893. (p. 116)



Knocker. French ; 15th century. In the Victoria and Albert Museum, no. 617-1895. (p. 116)



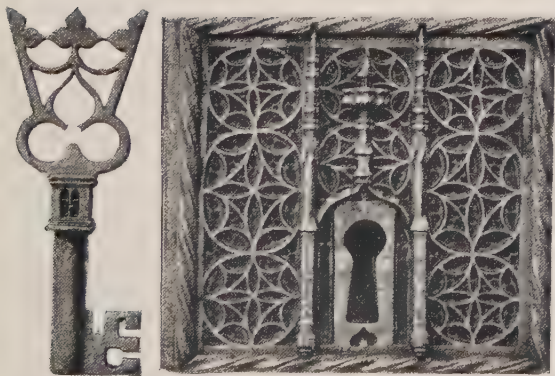
Pair of hinges of geometric design. French; about 1500. In the Victoria and Albert Museum, nos. 3596, 3597-1856. (p. 116)



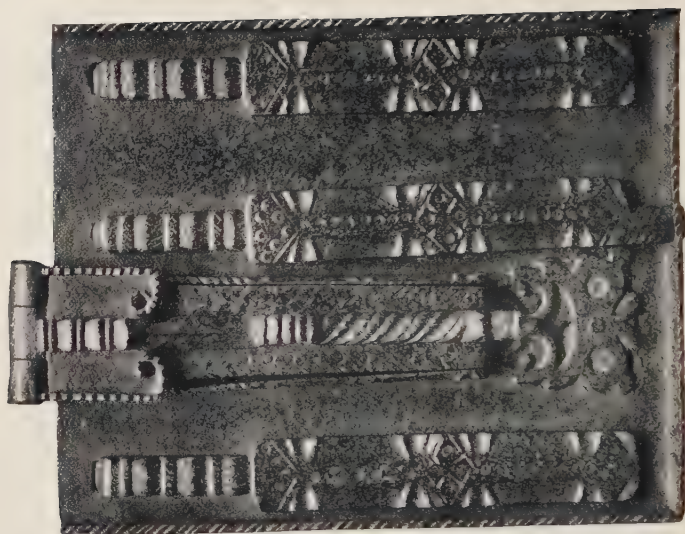
Tracery border from a casket. French; 15th century. In the Victoria and Albert Museum, no. 540-1895. (p. 113)



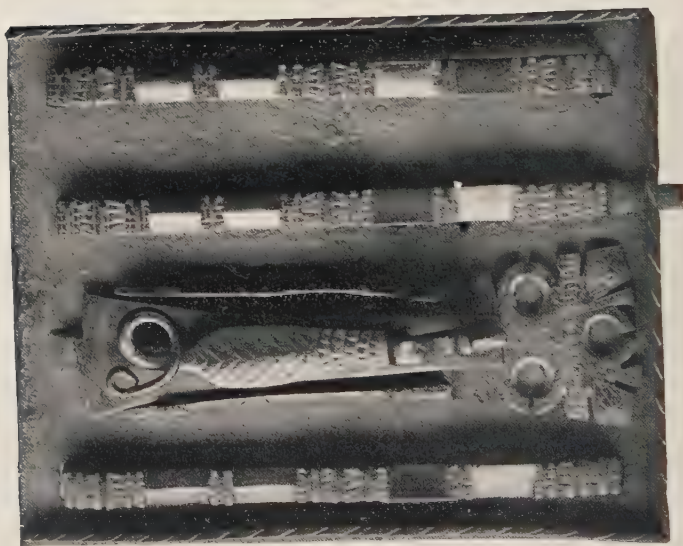
Handle. German; 15th century.
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no. 1109-1904. (p. 116)



Lock and key. French; 15th century. In the
Victoria and Albert Museum, no. 1697-1888.
(p. 116)



Chest-lock. French; late 15th century. In the
Victoria and Albert Museum, no. 594-1895.
(p. 116)



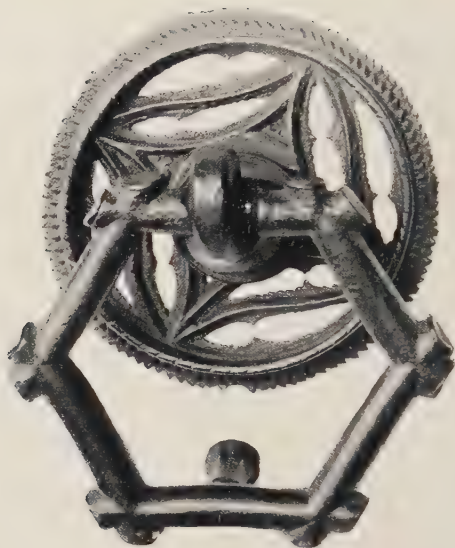
Chest-lock. French; late 15th century. In the
Victoria and Albert Museum, no. 506-1895.
(p. 116)



Bolt and lock-plate. French ; 15th century. In the
Victoria and Albert Museum, no. 622-1895.
(p. 116)



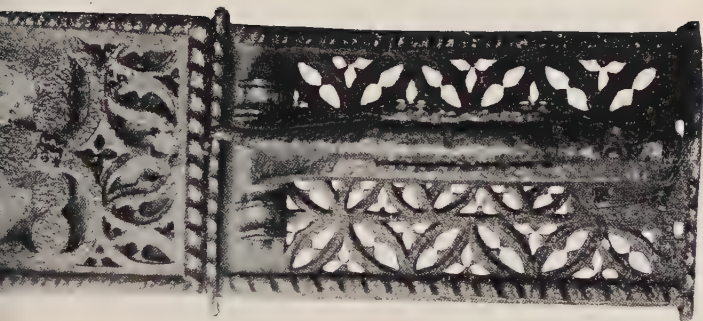
Lock-plate. French ; 15th century. In the
Victoria and Albert Museum, no. 521-1895.
(p. 116)



Knocker. French ; late 15th century.
In the Victoria and Albert Museum, no. 579-1895. (p. 117)



Knocker. German ; early 15th century.
In the Victoria and Albert Museum, no. 7652-1861. (p. 117)



Knocker with plate. French; about 1500.
In the Victoria and Albert Museum,
no. 519-1895. (p. 117)



Chest-lock, inscribed to the glory of the Virgin.
French; 15th century. In the Victoria and
Albert Museum, no. 539-1895. (p. 117)



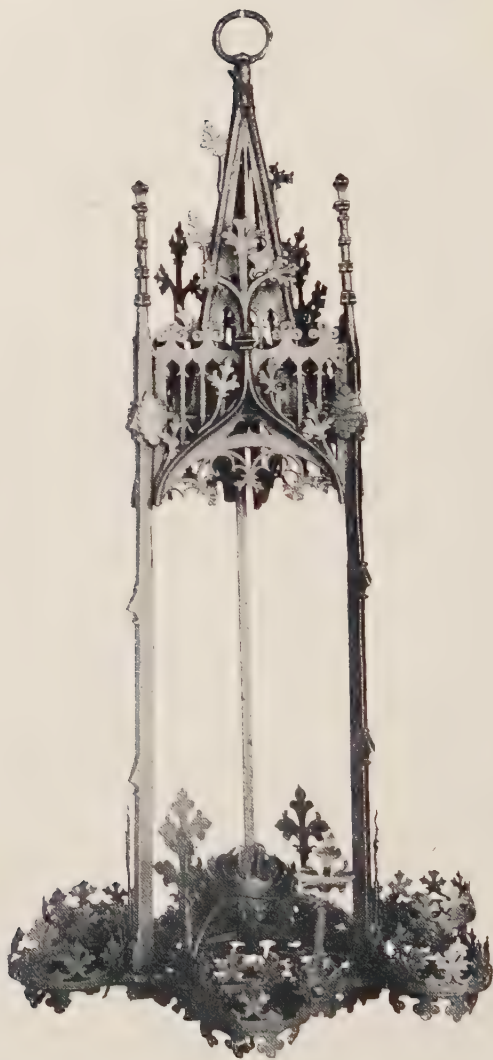
Door-knocker. German; 15th century.
In the Victoria and Albert Museum.



Door-knocker. Spanish; early 16th century.
In the Victoria and Albert Museum.



Candle-bracket. Flemish ; late 15th century.
In the Victoria and Albert Museum,
no. 500-1897. (p. 123)



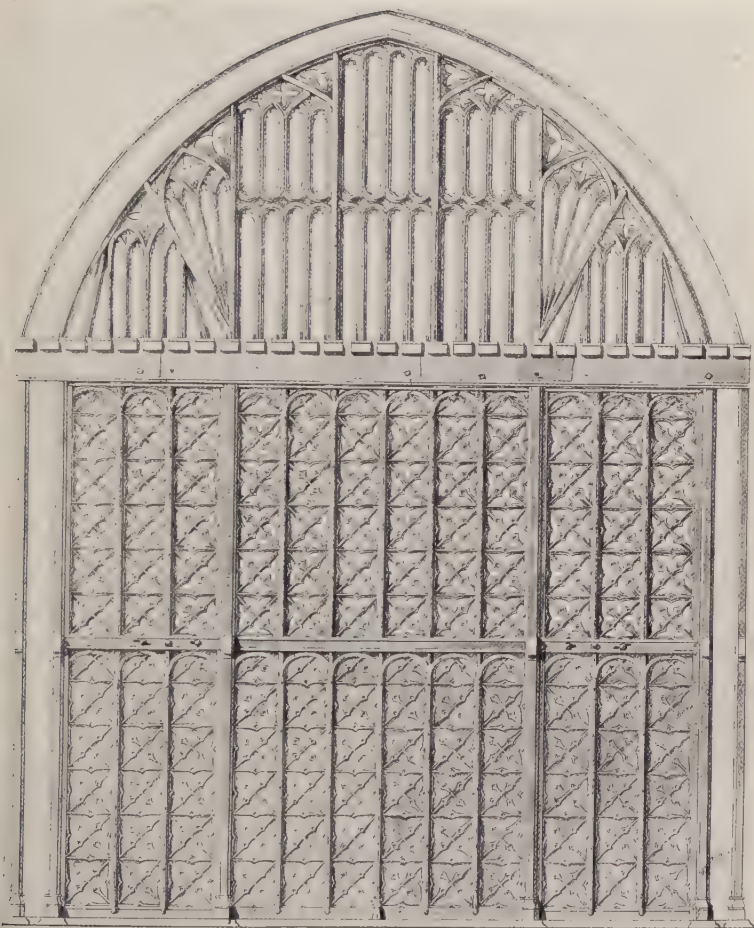
Chandelier. German ; 15th century. In the
Victoria and Albert Museum, no. 5990-1857.
(p. 124)



Portable lectern. Spanish ; 15th century. In the
Victoria and Albert Museum, no. 574-1897.
(p. 124)



Fire-dog. German or Flemish; 15th century. In the
Victoria and Albert Museum, no. 1015-1893.
(p. 124)



“ Joiner’s ” grille, Henry V. Chantry, Westminster Abbey.
Made by Roger Johnson, 1425-1431. (p. 126)



Upper part of gate pier, St. George's Chapel, Windsor.
Made by John Tresilian. Late 15th century.
(p. 127)



"Vizzying," or guichet, with iron wattlework. English; end of 15th century. In the Victoria and Albert Museum, no. 138-1889. (p. 129)

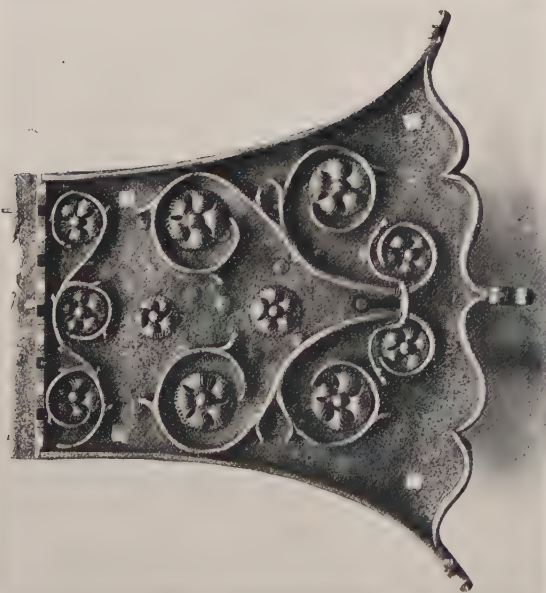




Tabernacle grille from Ottoburg, Tyrol. German; 15th century.
In the Victoria and Albert Museum, no. 534-1872. (p. 130)



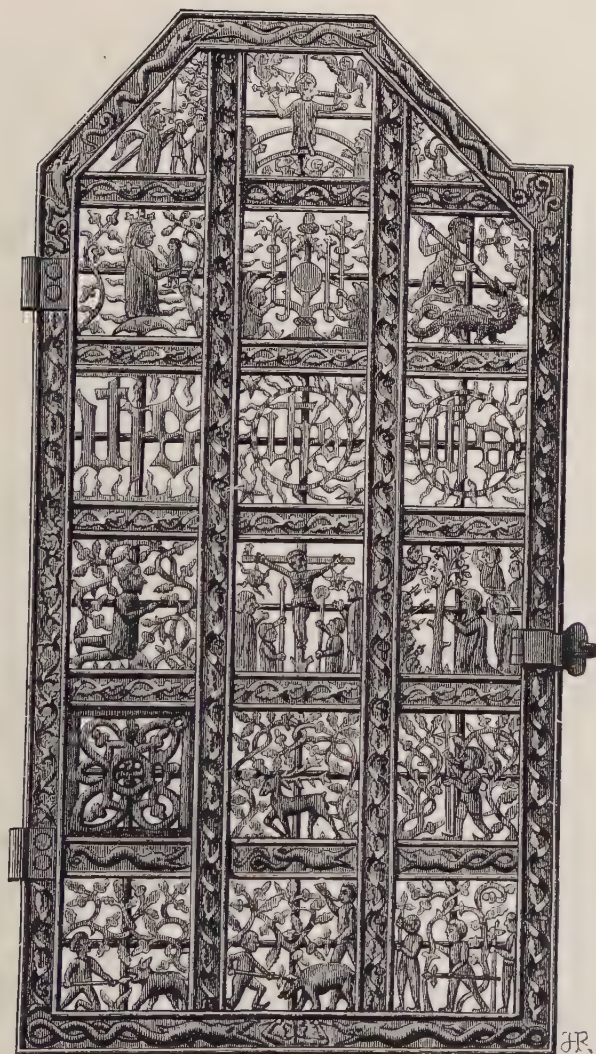
Iron clock of architectural design. German ; 15th century ;
with slight restorations. In the Victoria and Albert Museum,
no. 1203-1864. (p. 131)



Locks. German ; late 15th century. In the Victoria and Albert Museum, nos. 1046, 1047-1893. (p. 134)



Door from Nuremberg. German ; late 15th century. In the
Victoria and Albert Museum, no. M. 254-1921. (p. 137)



Tabernacle door in the sacristy of the Hospital Church
at Krems. Late 15th century. (p. 137)

NOTICE.

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